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A Treatise on the Cultivation of the Vine, and the Method of making Wines. By C. CHAPTAL.

(Concluded from page 362.)

III. General Precepts respecting the Art of managing Fermentation.

WHEN the grapes have acquired the proper degree of maturity, if the atmosphere be not too cold, and if the vintage be of the proper volume, fermentation has no need of aid or assistance. But these conditions, without which it is impossible to have a good result, are not always united, and it belongs to art, in order to obtain a good fermentation, to combine all these favourable circumstances, and to remove every thing prejudicial.

The faults of fermentation arise naturally from the quality of the grapes, which are the subject of it; and from the temperature of the air, which may be considered as a very powerful auxiliary.

Grapes may not contain a sufficiency of sugar to produce a sufficient formation of alcohol: and this vice may be owing to the grapes not having attained to maturity, or to the

sugar being diluted in too considerable a quantity of water; or because sugar, by the nature of the climate, cannot sufficiently develope itself. In all cases there are two ways of correcting the vice which exists in the nature of the grapes; the first consists in conveying into the must that principle which it wants: a proper addition of sugar presents to fermentation the materials necessary for the formation of alcohol, and the deficiency of nature is supplied by art. The antients, it appears, were acquainted with this process, since they mixed honey with the must which they caused to ferment. At present, direct experiments have been made on this subject; but I shall confine myself to transcribe here the results of those made by Macquer.

"In the month of October 1776 I procured from a garden at Paris a quantity of the white grapes called *pineau* and *melier* sufficient to make from twenty-five to thirty quarts of wine. They were waste grapes, and taken, purposely, in a bad state of maturity, that there might be no hopes of making potable wine from them: in nearly about a half of them, single grapes and even whole clusters were so green that their acidity was insupportable. Without taking any other precaution than to separate what were putrid, I caused the rest to be bruised with the stalks, and the juice to be expressed with the hand: the must which issued from them was exceedingly turbid, of a dirty-green colour and of a sweetish sour taste, in which the acid predominated so much that it caused those who tasted it to make wry faces. I dissolved in this must a sufficient quantity of brown sugar to give it the taste of pretty good sweet wine; and without boiler, funnel, or furnace, I put it into a cask in an apartment at the bottom of the garden, where it was left to itself. Fermentation took place in it on the third day, and maintained itself for eight days in a very sensible manner, but still very moderate. After that time it ceased spontaneously.

"The wine thence resulting being newly made, and still turbid, had a pretty strong and pungent vinous odour; its taste was somewhat harsh; while that of the sugar had disappeared as completely as if it had never existed. I suffered it to remain in the cask during the winter; and having examined it in the month of March, I found that, without having been drawn off or strained, it had become clear; its taste, though still pretty strong and pungent, was, however, much more agreeable than it had been immediately after the sensible fermentation; it had something sweeter and more racy, but was mixed with nothing that approached to sugar. I then put the wine in bottles, and having examined it in the month of October 1777, I found it to be clear, fine, exceedingly brilliant, agreeable to the taste, generous, and warm; in a word, like good white wine made from pure grapes which has nothing luscious, the produce of a good vineyard in a good year. Several connoisseurs, whom I made to taste it, gave it the same character, and could not believe that it had been made from green grapes, the taste of which had been corrected with sugar.

"This success, which exceeded my hopes, induced me to make a new experiment of the same kind, and still more decisive, on account of the extreme greenness and the bad quality of the grapes which I employed.

"On the 6th of November 1777 I caused to be collected, from the top of an arbour in a garden at Paris, a kind of large grapes which never ripen properly in this climate, and which we know only under the name of *verjus*, because they are used for no other purpose than to express the juice before it becomes spoiled, that it may be employed as a kind of sour seasoning in cookery. Those here alluded to had scarcely begun to rot though the season was far advanced, and they had been abandoned on the arbour as leaving no hope of their acquiring suf-

ficient maturity to be fit for the table. They were still so hard that I resolved to make them burst over the fire in order to extract the juice: the quantity they furnished was about eight or nine quarts. This juice had a very acid taste, in which there could scarcely be distinguished a very slight saccharine savour. I dissolved some of the commonest cassonade* until it appeared to me to be very saccharine. It required a great deal more than for the wine of the preceding experiment, because the acidity of the latter must was much stronger. After the sugar was dissolved, the taste of the liquor, though very saccharine, had nothing agreeable, because the sweet and the sour were perceived pretty strongly and separately in a disagreeable manner.

"I put this kind of must into a jar so as not to be entirely full, and covered it only with a cloth: as the season was already very cold, I placed it in an apartment where the heat was always maintained at 12 or 13 degrees (59 to 61 F.) by means of a stove.

"Four days after the fermentation was not yet very sensible, the liquor appeared to me to be as saccharine and as acid; but these two tastes beginning to be better combined, the result was a whole more agreeable to the taste.

"On the 14th of November the fermentation was in full force: a lighted taper introduced into the empty part of the jar, was speedily extinguished.

"On the 30th the sensible fermentation had entirely ceased, and the taper was no longer extinguished in the interior of the jar. The wine which resulted from it was, however, very turbid and whitish; its taste had scarcely any thing saccharine; it was strong, pungent, and pretty agreeable, like that of generous warm wine, but a little gaseous and green.

"I closed the jar and put it into a cool place, that the

* Brown Sugar.

wine might bring itself to perfection by insensible fermentation during the whole winter.

"Having examined this wine on the 17th of March 1778, I found that it was almost entirely clear, the remains of its saccharine as well as its acid taste had disappeared. The latter was that of pretty strong wine made from pure grapes: it was not unpleasant, but had no perfume or *bouquet*, because the grapes, which we call *verjus*, contain no odorous principle or aroma: these excepted, this wine, which was quite new, and which still had to gain by that fermentation which I call *insensible*, promised to become racy and agreeable."

These experiments seem to me to prove, beyond all doubt, that the best method of remedying the want of maturity in grapes is to follow the process indicated by nature; that is to say, to introduce into the must that quantity of saccharine principle necessary which it could not give them. This method is the more practicable, as not only sugar, but also honey. molasses, and every other saccharine matter of an inferior price can produce the same effect, provided they have no disagreeable accessary taste which cannot be destroyed by good fermentation.

Bullion caused the juice of grapes, taken from his park at Bellegames, to ferment by adding from 15 to 20 pounds of sugar per *muid*.* The wine they produced was of a good quality.

Rozier, long ago, proposed to facilitate the fermentation of must, and ameliorate wines by the addition of honey, in the proportion of a pound to two hundred of must. All these processes depend on the same principle, viz. that no alcohol is produced where there is no sugar; and that the formation of alcohol, and consequently the generous nature of wine, is constantly proportioned to the quantity of sugar existing in the must: it is thence evi-

* 280 quarts.

dent that wine may be carried to any degree of spirituosity required, whatever may be the primitive quality of the must, by adding to it more or less sugar.

Rozier has proved, and the same result may be obtained by calculating the experiments of Bullion, that the value of the produce of the fermentation is very far superior to the price of the matters employed; so that these processes may be presented as objects of economy and matter of speculation.

It is possible also to correct the quality of the grapes by other means, which are daily practised. A portion of the must is boiled in a kettle; it is concentrated to one-half, and then poured into a vat: by this, method the aqueous portion is in part dissipated, and the portion of sugar being then less diluted, the fermentation proceeds with more regularity, and the produce is more generous. This process, almost always useful in the north, cannot be employed in the south, but when the season has been rainy or when the grapes have not been sufficiently ripe.

The same end may be attained by drying the grapes in the sun, or exposing them for the same purpose in stoves, as is practised in some wine countries.

It is perhaps for the same reason, always with a view to absorb the moisture, that plaster is sometimes put into the vat, as was practised by the ancients.

It sometimes happens that the must is both too thick and too saccharine: in that case the fermentation is always slow and imperfect; the wines are sweet, luscious, and thick; and it is not till after remaining a long time in the bottles that it becomes clear, loses its disagreeable thickness, and only exhibits good qualities. The greater part of the white Spanish wines are in this situation. This quality of wine has however its partisans, and there are some countries where the must is concentrated for that purpose, in others the grapes are dried in the sun or

in stoves till they are reduced almost to the consistence of an extract.

It would be easy in all cases to excite fermentation, either by diluting the must, when too thick, with water, or by agitating the vintage in proportion as it ferments: but all this must be subordinate to the end proposed to be obtained, and the intelligent agriculturist will vary his processes according to the effect which he intends to produce.

It must never be forgotten, that the fermentation ought to be managed according to the nature of the grapes and agreeably to the quality of the wine that may be required. Burgundy grapes cannot be treated like those of Languedoc. The merit of the one consists in a peculiar flavour, which would be dissipated by a strong and lengthened fermentation: that of the other in the great quantity of alcohol which may be developed in them; and here the fermentation in the vat must be long and complete. In Champagne, the grapes destined for the white brisk wines are collected in the morning before the sun has caused all the moisture to evaporate; and in the same country the grapes destined for making red wine are not cut until they have been well dried by the rays of the sun. In one place artificial heat is necessary to excite fermentation, in another the nature of the must is such that the fermentation would require to be moderated. Weak wines must be fermented in casks, strong wines ought to be suffered to work in the vat. Every country has processes prescribed to it by the nature of its grapes, and it is highly rediculous to attempt submitting every thing to a general rule. It is of importance to be well acquainted with the nature of the grapes employed and with the principles of fermentation: by the help of this knowledge a system of conduct may be formed which cannot fail of being highly advantageous.

because it is founded not on hypothesis but on the nature of things.

In cold countries, where the grapes are very aqueous and little saccharine, they ferment with difficulty: fermentation in that case may be excited by two or three principal means:

1st, By the help of a funnel of tin plate with a very wide tube, which descends to within four inches of the bottom of the vat, and through which boiling must is introduced into it. Two pailfuls may be used for 300 bottles of must. This process proposed by Maupin, has produced good effects.

2d, By shaking the vintage from time to time: this motion is attended with this advantage, that it renews the fermentation when it has ceased or become weak, and causes it to be uniform throughout the mass.

3d, By laying a covering not only over the vintage, but round about the vat.

4th, By heating the atmosphere of the place in which the vat stands.

It often happens that the working of the vintage slackens, or that the heat is unequal through the mass: it is to obviate these inconveniences, especially in cold countries, where they are more frequent, that the vintage is from time to time trod upon. Gentil made two vatfuls, of eighteen butts each, and with grapes from the same vines, and collected at the same time: the grapes were freed from the skins, stalks, &c. and bruised; the juice of both was perfectly equal in quality, and the vintage was put into vats of equal size: the weather, but particularly in the morning and at night, was exceedingly cold.

At the end of some days the fermentation began: it was observed that the centre of the vats was exceedingly warm and the edges very cold; the vats were so close as

to touch each other, and both experienced the same temperature. They were pressed down with a long pole. The cold vintage was pushed from the edges towards the centre where the heat was strongest: it was pressed down several times, and by these means an equal heat was maintained throughout the whole mass. The fermentation in the vat where this process had been followed was finished twelve or fifteen hours sooner than in the other. The wine was far better, it was more delicate, had a superior taste, and was more highly coloured and more generous. No one would have said that it was produced from the same grapes.

The antients mixed aromatic substances with the vintage in a state of fermentation, in order to give their wines peculiar qualities. We are told by Pliny that it was usual in Italy to sprinkle pitch and resin over the vintage *ut odor vino contingeret et saporis acumen.* In all the works of that period we find numerous recipes for perfuming wines; but these different processes are no longer used. I am, however, inclined to think that they were of great benefit. This very important part of oinology deserves the particular attention of the agriculturist. When we consider the custom followed in some countries of perfuming the wines with raspberries, the dried flowers of the vine, &c. we may even presage the happiest effects from it.

Darcet has communicated to me the following facts, which I take the earliest opportunity of publishing here, as they may give rise to experiments proper for improving the art of vinification.

"I took," says he, "a cask called half a *muid*, which I filled with the juice of untrod grapes, and such as had run of itself from the grapes as carried from the vineyard to the press: it therefore had very little colour.

"This cask contained about 150 quarts. I took about thirty quarts, which I evaporated and concentrated to nearly about one-eight of the volume of the liquor; four pounds of common sugar were added, and a pound of grapes *de careme*, after care had been taken to bruise them: the whole, somewhat warm, was then put into the cask, which was filled up with the same must that had been kept apart. A bunch, of about half an ounce, of absinthium, dried and well preserved, was then put into the cask, and the cask was slightly covered, with its lid inverted: fermentation soon took place, and proceeded in a brisk and free manner.

"Besides this piece of must, I caused to ferment also a jar of the same containing about twenty-five or thirty quarts, with half an ounce of sugar per quart: this wine fermentated very well in this jar, and it served me for filling up during the fermentation and after the first drawing off, which was performed at the usual time, and repeated a year after: it was afterwards put into bottles at the expiration of a year, or in the following winter.

"This wine was made in September 1788, during fine weather, and in a very good year.

"It kept very well even in the bottle, it neither became sour nor turbid at the end of several days; I have still two or three bottles of it: it begins to fade."

IV. Ethiology of Fermentation.

The phænomena and result of fermentation are so highly interesting in the eyes of the chemist and the agriculturist, that, after having considered them merely under a practical point of view, we must now consider them under the relation of science.

The two phænomena which seem most worthy of attention from the chemist, are the disappearance of the saccharine principle and the formation of alcohol.

As in fermentation there is no absorption of air, nor addition of any foreign matter, it is evident that all changes which take place in the operation can be referred only to the departure of those substances which are volatilised or precipitated.

Thus, by studying the nature of these substances, and ascertaining their constituent principles, it will be easy for us to judge of the changes which must have been produced in the nature of the first materials of fermentation.

The materials of fermentation are the sweet and saccharine principle diluted in water. This principle is formed of sugar and extractive matter.

The substance volatilised is the carbonic acid gas, and that precipitated is a matter analogous to the ligneous fibre mixed with potash.

The principal product of fermentation is alcohol.

It is evident that the transition of the saccharine principle to alcohol cannot be conceived but by calculating the difference which must be produced in the saccharine principle by the departure of the principles that form carbonic acid gas which is volatilised, and the deposit which is precipitated.

These principles are, in particular, the carbon and the oxygen: here, then, we find carbon and oxygen taken from the saccharine principle by the progress of fermentation; but in proportion as the saccharine principle loses its oxygen and its carbon, the hydrogen, which forms the third constituent principle, remaining the same, the characters of the latter element must predominate, and the fermenting mass must attain to that point at which it will only present an inflammable fluid.

In proportion as the alcohol is developed, the liquid changes its nature; it no longer has the same affinities, nor, consequently, the same dissolving power. The small quantity of extractive principle which remains after hav-

ing escaped decomposition is precipitated with the carbonat of potash: the liquor becomes clear, and the wine is made.

Vinous fermentation, then, is nothing but the continued departure of carbon and oxygen, which produces on one hand the carbonic acid, and on the other alcohol. The celebrated Lavoisier subjected to calculation all the phænomena and results of vinous fermentation, comparing the products of the decomposition with its elements. He assumed as the basis of his calculations the data furnished to him by analysis both in regard to the nature and the proportions of the constituent principles before and after the operation. We shall here transcribe the results obtained by this great man.*

Materials of Fermentation for a Quintal of Sugar.

		lib.	*oz.*	*dr.*	*gr.*
Water		400	0	0	0
Sugar		100	0	0	0
Yeast of beer in paste composed of	Water	7	3	6	44
	Dry yeast	2	12	1	28
	Total	510	0	0	0

Detail of the constituent Principles of the Materials of Fermentation.

lib.	*oz.*	*dr.*	*gr.*		*lib.*	*oz.*	*dr.*	*gr.*
407	3	6	44	Of water composed of				
				Hydrogen	61	1	2	71·40
				Oxygen	346	2	3	44·60
100	0	0	0	Sugar composed of				
				Hydrogen	8	0	0	0
				Oxygen	64	0	0	0
				Carbon	28	0	0	0
2	12	1	28	Dry yeast composed of				
				Carbon	0	12	4	59·00
				Azot	0	0	5	2·94
				Hydrogen	0	4	5	9·30
				Oxygen	1	10	2	28·76
				Total	510	0	0	0

* Elements of Chemistry, p. 190.

Recapitulation of the constituent Principles of the Materials of Fermentation.

		lib.	*oz.*	*dr.*	*gr.*	*lib.*	*oz.*	*dr.*	*gr.*
Oxyg.	Of the water	340	0	0	0				
	Of the water of the yeast	6	2	3	44·60				
	Of the Sugar	64	0	0	0	411	12	6	1·36
	Of the dry yeast	1	10	2	28·76				
Hydr.	Of the water	60	0	0	0				
	Of the water of the yeast	1	1	2	71·40	9	6	0	8·70
	Of the sugar	8	0	0	0				
	Of the yeast	0	4	5	930				
Carb.	Of the sugar	28	0	0	0	28	12	4	59·00
	Of the yeast	0	12	4	59·10				
Azot of the yeast						0	0	5	2·94
						510	0	0	0

Table of the Results obtained by Fermentation.

lib.	*oz.*	*dr.*	*gr.*			*lib.*	*oz.*	*dr.*	*gr.*
35	5	4	19						
Of carbonic acid, composed of				Oxygen		25	7	1	34
				Carbon		9	14	2	57
408	15	5	14						
Of water composed of				Oxygen		347	10	0	59
				Hydrogen		61	5	4	27
57	11	1	58	Oxygen combined with hydrogen		31	6	1	64
Of dry alcohol composed of				Hydrogen combined with oxygen		5	8	5	3
				Hydrogen combined with carbon		4	0	5	0
				Carbon combined with hydrogen		16	11	5	63
2	8	0	0						
Of dry acetous acid, composed of				Hydrogen		0	2	4	0
				Oxygen		1	11	4	0
				Carbon		0	10	0	0
4	1	4	3						
Of saccharine residuum, composed of				Hydrogen		0	5	1	67
				Oxygen		2	9	7	27
				Carbon		1	2	2	53
1	6	0	50	Hydrogen		0	2	2	41
Of dry yeast composed of				Oxygen		0	13	1	14
				Carbon		0	6	2	30
				Azot		0	0	2	37
510	0	0	0			510	0	0	0

Recapitulation of the Results obtained by Fermentation.

							lib.	*oz.*	*dr.*	*gr.*
					Of the water . .		347	10	0	59
lib.	*oz.*	*dr.*	*gr.*		Of the carbonic acid .		25	7	1	34
409	10	0	54		Of the alcohol . .		31	6	1	64
Oxygen .					Of the acteous acid .		1	11	4	0
					Of the saccharine residuum		2	9	7	27
					Of the yeast . .		0	13	1	14
					Of the carbonic acid .		9	14	2	57
28	12	5	59		Of the alcohol . .		16	11	5	63
Carbon .					Of the acteous acid .		0	10	0	0
					Of the saccharine residuum		1	2	2	53
					Of the yeast . .		0	6	2	30
					Of the water . .		61	5	4	27
					Of the water of the alcohol		5	8	5	3
71	8	6	66		Combined with the carbon in the alcohol . .		4	0	5	0
Hydrogen					Of the acteous acid .		0	2	4	0
					Of the saccharine residuum		0	5	1	67
					Of the yeast . . .		0	2	2	41
0	0	2	37							
Of Azot .					. . . . .		0	0	2	37
510	0	0	0				510	0	0	0

By reflecting on the results exhibited by these tables, we may clearly see what takes place in the vinous fermentation: it is first observed that, of the 100 pounds of sugar employed, 4 lib. 1 oz. 4 dr. 3 gr. remained in the state of undecomposed sugar; so that the quantity of sugar really subjected to operation was only 95 lib, 14 oz. 3 dr. 69 gr.; that is to say, 61 lib. 6 oz. 45 gr. of oxygen, 7 lib. 10 oz. 6 dr. 6 gr. of hydrogen, and 26 lib. 13 oz. 5 dr. 19 gr. of carbon. But by comparing the quantities it will be found that they are sufficient to form all the spirit of wine, all the carbonic acid, and all the acetous acid, produced by the fermentation.

The effects of vinous fermentation are reduced, then, to the separating into two portions the sugar, which is an oxyd; oxygenating the one at the expense of the other to

form carbonic acid; deoxygenating the other in favour of the former to produce a combustible substance, which is alcohol; so that, if it were possible to combine these two substances, the alcohol and carbonic acid, sugar would be re-formed. It is to be observed also, that the hydrogen and carbon are not in the state of oil in the alcohol; they are combined with a portion of oxygen, which renders them miscible with water: the three principles, oxygen, hydrogen, and carbon, are here, then, still in a kind of state of equilibrium; and, indeed, by making them pass through an ignited glass or porcelain tube, they may be re-combined two and two, and water and hydrogen, carbonic acid and carbon, are again found.

V. The Method of taking the Wine from the Vats, and the proper Period for that Purpose.

At all times agriculturists have considered it as a matter of great importance, to be able, by unerring signs, to discover the most favourable period for taking the wine from the vats; but here, as in other things, they have fallen into the very great inconvenience of general methods. This period ought to vary according to the climate, the season, and the nature of the wine proposed to be obtained, and of other circumstances, which must always be kept in view.

It will be proper for us, therefore, to lay down principles rather than to prescribe methods; for, in our opinion, this is the only way to make ourselves masters of the operations, and to bring together the whole of those phænomena, the knowledge and comparison of which become necessary before any dscision, founded upon certainty, can be given.

Some agriculturists have ventured to determine a fixed period for fermentation; as if it ought not to vary according

to the temperature of the air, the nature of the grapes, the quality of the wine, &c. Others consider as a sign that the wine is fit to be removed from the vats, the sinking down of the vintage, being certainly ignorant that almost the whole of the wines of the North would lose their most valuable qualities, if their removal of the vats were delayed till that time.

There are some countries where it is judged that the fermentation is completed, when the wine, after being put into a glass, exhibits no foam at the top, and no air-bubbles at the sides of the glass. In other places it is thought sufficient to shake the wine in a bottle, or to pour it from one glass into another several times, to ascertain whether there exists any foam. But besides that all new wines give more or less foam, there are many in which that mark of effervescence ought to be preserved, in order that they may not lose one of their principal properties.

In some countries, a stick is immersed in the vat, and speedily drawn out; the wine is then suffered to drop from it into a glass, to see whether a circle of foam is formed in it, which is called *faire la roue.* Some thrust their hand into the refuse, and, applying it to their nose, judge, by the smell, of the state of the vat: if the smell is mild, they allow the wine to ferment some time longer; if it is strong, it is removed from the vats.

Some agriculturists, also, consult only the colour in order to regulate the period of removing the wine from vats. They suffer it to ferment till the colour becomes sufficiently dark: but the coloration depends on the nature of the grapes; and must in the same climate, and produced from the same soil, does not always show the same disposition to acquire colour; which renders this sign exceedingly variable and very insufficient.

It thence follows, that all these signs, taken separately, cannot exhibit invariable results; and that, if we wish to

rest on fixed bases, recurrence must be had to principles.

The object of fermentation is to decompose the saccharine principle: the more abundant, therefore, this principle is, the fermentation must be brisker, or continued for a longer time.

One of the inseparable effects of fermentation is, the production of heat and carbonic acid gas. The first of these results tends to volatilize and to disperse the flavour and smell, which forms one of the principal characters of certain wines. The second carries outwards, and causes to be lost in the air a fluid, which if retained in the beverage would render it more agreeable and pungent. From these principles it follows, that weak wines, but of an agreeable flavour, require little fermentation; and that colourless wines, the principal property of which is to be brisk, ought to remain scarcely at all in the vats.

The most immediate product of fermentation is the formation of alcohol, which results immediately from the decomposition of the sugar. When the grapes, therefore, are very saccharine, such as those of the south, the fermentation must be brisk, and long continued; because these wines, being destined for distillation, ought to produce immediately all the alcohol that can result from the decomposition of the whole of the saccharine principle. If the fermentation be slow and weak, the wines remain luscious, and do not become warm and agreeable till they have long worked in the vats.

In general, grapes abundant in the saccharine principle must ferment a long time. In the Bordelois, the fermentation is suffered to work itself to an end: the wine is never removed from the vats till the heat has subsided.

According to these principles and others, deduced from the theory before established, we may draw the following consequences:

1st, The must ought to remain in the vats the less time according as it is less saccharine. Light wines, called in Burgundy *vins de primeur*, cannot bear the vat above from six to twelve hours.

2d, The must ought to remain the less time in the vats, according as it is proposed to retain the acid gas, and to form brisk wines: in that case, it is thought sufficient to tread the grapes, and to put the juice into the casks after it has been left in the vat twenty-four hours, and sometimes without having been in the vat at all. In this case, the fermentation, on the one hand, is less tumultuous; and, on the other, the gas can with less ease be volatilized; which contributes to retain that highly volatile substance, and to make it one of the principles of the liquor.

3d, Must ought to be left in the vats less time, according as it is proposed to obtain wine less coloured. This condition is of great importance in regard to brisk wines, one of the most valuable qualities of which is their want of colour.

4th, Must ought to remain in the vats less time, according as the temperature is warmer, and the mass more voluminous, &c.: in that case, the briskness of the fermentation makes up for its shortness of duration.

5th, The must ought to remain in the vats less time, according as it is proposed to obtain wine of a more agreeable flavour.

6th, The fermentation, on the other hand, will be longer, according as the saccharine principle is more abundant, and the must thicker.

7th, It will be longer if the wines are destined for distillation; in which case, every thing ought to be sacrificed to the production of alcohol.

8th, The fermentation will be longer, according as the temperature has been colder when the grapes were collected.

9th, The fermentation will be longer, according as the wine is required to be more coloured.

From these principles it may be conceived why in one country the fermentation in the vat terminates in twenty-four hours, while in others it continues for twelve or fifteen days; why one method cannot be generally applied; and why particular processes may be attended with errors, &c.

Gentil admits as an invariable sign of the necessity of removing the wine from the vat, the disappearance in regard to taste of the sweet and saccharine principle. This disappearance, as he observes, is only apparent, but the savour of the little that remains is concealed; the alcohol, the savour of which predominates, terminates its decomposition in the casks. It is also evident that this sign, which is not at all applicable to white wine, cannot be employed for wines destined to remain luscious.

The signs deduced from the sinking down of the head or refuse, and the coloration of wines, are attended with the like inconveniences, and we must return from them to the principles above established. This is the only method of avoiding error.

A provident agriculturist will always pepare his casks, on the approach of the vintage, in such a manner that they may be ready to receive the wine as it comes from the vat. The preparation given to them is as follows:

If the casks are new, the wood of which they are composed retains an astringency and bitterness, which may be transmitted to the wine; and these faults may be corrected by pouring warm water and salt water into them several times in succession. These liquors must be well shaken, and suffered to remain in them till they penetrate the texture of the wood, and extract the pernicious principle. If the casks are old, and have been frequently employed, one end of them is opened: the stratum of

tartar, with which the inside is covered, is scraped off, and they are washed with warm water or with wine.

In general, the most usual methods of preparing the casks are confined to the following :

1st, Wash the cask with cold water, then pour into it a quart of salt water in a state of ebullition; stop the bunghole, and shake it in every direction : empty it, let the water drain well off; then take two quarts of fermenting must, and, having boiled and skimmed it, pour it boiling hot into the cask; close it and again shake it, after which suffer it to drain off.

2d, Warm wine may be employed instead of the above preparations.

3d, An infusion of the flowers of the peach-tree, &c. may also be used.

When the casks have acquired any bad quality, such as mustiness, &c. they must be burnt : it is possible to conceal these defects, but there is reason to fear they might reappear.

The antient Romans put gypsum, myrrh, and various aromatic substances into the casks into which their wines were removed from the vat. This is what they called *conditura vinorum.* The Greeks sometimes added a little bruised myrrh and argil. These substances not only perfumed the wine, but served also to clarify it.

When the casks are properly prepared, they are deposited on cask-stands, and thus raised some inches from the ground, both to prevent the action of putrid humidity, and for the more convenient drawing off the wine which they contain. They must be arranged in parallel rows in the cellar, with sufficient room between for a person to examine whether any of them leaks.

In the casks thus prepared the wine is deposited : when it is thonght to have remained a sufficient time in the vat for this purpose, the tap of the vat, which is raised some

inches above the ground, is opened, and the wine is suffered to run into a reservoir, generally constructed below, or into a vessel placed on purpose to receive it: the wine is immediately drawn from the reservoir and carried to the casks, into which it is introduced by means of a funnel.

The liquor which floats over the deposit of the vat is called in Burgundy *surmoût*. This *surmoût* is carefully drawn off, and put into casks capable of containing 30 gallons, or into half casks of 15. This *surmoût* forms a lighter kind of wine, more delicate and less coloured.

When all the wine which the vat can furnish has been drawn off, nothing remains but the head, which has sunk down almost to the deposit. This refuse is still impregnated with wine, and retains such a quantity, that it may be extracted by means of the press. But as the head, which has been in contact with the atmospheric air, for the most part contracts a little acidity, especially when the vintage has remained a long time in the vat, it must be carefully separated, in order to be pressed by itself; by which means it will produce very good vinegar.

When the deposit in the vat has been pressed, the wine that flows from it is put into the casks with the rest; after which the press is eased, and the refuse is cut quite round, to the thickness of three or four inches, with a sharp shovel; that which has been cut off is thrown into the middle, and again subjected to the press: the operation of cutting is a second time repeated, and the cut matter is pressed as before.

The wine arising from the first *cutting* is the strongest; that arising from the third is harder, harsher, greener, and more coloured.

Sometimes a first cutting is thought sufficient, especially when the refuse is destined for the acetous fermentation. The product of these different cuttings is often mix-

ed together in separate casks, in order to obtain wine coloured and pretty durable; and in some places it is mixed with common wine when it is required to give to the latter colour, strength, and a slight astringency. In Champagne, the wine of the first pressing is mixed with that arising from succeeding cuttings.

The wine of the press is the less coloured according as it is pressed more weakly and more speedily. These wines in Champagne are called *gray wines.* The wine arising from the first and second cutting is called *œil de perdrix;* and that arising from the third and fourth, *vin de taille:* the last is the most coloured, but it is still agreeable.

The refuse, when strongly pressed, acquires sometimes the hardness of stone. It is applied to various uses in commerce.

1st, In some countries it is distilled in order to make a spirit, which is called *eau-de-vie de marc.* In Champagne it is known under the name of *eau-de d'Aixne;* but it has a bad taste. This distillation is advantageous, especially in countries where the wine is highly generous, and where the presses do not press very closely.

2d, In the neighbourhood of Montpellier, the refuse is put into casks, where it is carefully trod upon; and it is then preserved for making verdigris*.

3d, In other places it is rendered acid by carefully airing it, and the vinegar is then extracted by strong pressure. The expression may even be facilitated by moistening it with water.

4th, In several cantons the cattle are fed with the refuse: as it comes from the press, it is broken with the hands in order to divide the lumps; it is then thrown into casks, where it is moistened with water, aud it is covered with earth mixed with straw: this covering is about 7 or

* See Philosophical Magazine, Vol. IV.

8 inches in thickness. When bad weather prevents the cattle from going out into the fields, about 6 or 7 pounds of this refuse is soaked in warm water with bran, straw, turnips, potatoes, and oak or vine-leaves, which have been preserved on purpose in water: a little salt may be added to this mixture, which is given to the cattle in a tub evening and morning. Horses and cows are fond of this food; but it must be given to the latter in moderation, because it would cause their milk to turn sour. The refuse of white grapes is preferred on account of its not having been fermented.

5th, The stones contained in the grapes serve for feeding poultry: oil, also may be extracted from them.

6th, The refuse may be burnt to obtain alkali: 4000 pounds of refuse yield 500 pounds of ashes, which give 10 pounds of dry alkali.

VI. Of the Method of managing the Wine in the Casks.

The wine deposited in the casks has not reached its last degree of preparation. It is turbid, and still ferments; but, as the movement of it is less tumultuous, this state of it has been called the *insensible fermentation.*

Soon after the wine has been put into the cask, a slight hissing is heard, which arises from the continued disengagement of the carbonic acid gas that escapes from every point of the liquor; foam, which passes over through the bunghole, is formed at the top, and care is taken to keep the cask always full, that the foam may escape, and that the wine may disgorge itself. For a short time it will be sufficient to fasten a piece of paper on the bung, or to lay a tile over it.

In proportion as the fermentation decreases the mass of the liquid sinks down; and this depression is carefully watched, in order to pour in more wine, that the casks may be always kept full. There are some countries where

this operation is performed every day for the first month, every four days during the second, and every eight till it is drawn off. This is the method practised in regard to the delicious wines of the Hermitage.

In Champagne, the *gray wines* are suffered to ferment in the casks ten or twelve days; and when they cease working up, the casks are closed by means of the bung, leaving a small vent-hole at one side of it. This vent-hole is closed eight or ten days after with a wooden peg, which may be taken out at pleasure. When the casks have been closed, fresh wine must be poured in through the vent-hole, every week for twenty-five days; then every two months as long as the wine remains in the cellar. When the wines have not sufficient body, and are too green, which is the case when the season has been damp and cold; or if they are too luscious, which is the case when the season has been too dry and warm, the casks are rolled five or six times twenty-five days after the wine has been made, to mix well the lees; and this operation is repeated every eight days during a month: by these means the wine is improved.

The fermentation of the wines of Champagne destined to be brisk is continued very long: it is believed that wine can constantly be brisk, provided it be put into bottles between the time of the vintage till the month of May; and that, the nearer to the time of the vintage, the better it foams. We are assured also that it always foams if put into bottles between the 10th and 14th of March. Wine never begins to foam till six weeks after it has been put into bottles. Mountain wine foams better than Champagne: when wine is put into flasks between June and July it foams little, and not at all if bottled in October or November, after the vintage.

In Burgundy, when the fermentation in the cask has slackened, the casks are closed, and a small hole is made

in them near the bung, which is closed with a peg. This peg is drawn out from time to time to suffer the remainder of the gas to escape.

In the environs of Bordeaux it is customary to begin pouring in new wine eight or ten days after the wine has been put into the casks. A month after, the bung is put in, and new wine is poured in every eight days: at first, the bung is put in very gently, and it is gradually driven in closer without incurring any danger.

The white wines are drawn off about the middle of December, and they are then sulphured. The white require more care than the red, because they contain more dregs, and are more disposed to become oily.

Red wines are not drawn off till the end of March or beginning of April. The latter easier turn sour than the white, which renders it necessary to keep them in cooler cellars during the hot weather.

Some people, after the second drawing off, turn the barrels with the bung on one side, and thus keep the wine hermetically sealed, without having need to pour in new wine, as there is no loss. The wine then is not drawn off but every year at the same period, until it is found convenient to drink it. As the processes every where followed are nearly the same, we shall not multiply details, which would be only repetitions.

When the fermentation has ceased, and the mass enjoys perfect repose, the wine is completely made. But it acquires new qualities by clarification; and by this operation is preserved from the danger of turning sour.

This clarification is effected spontaneously by time and repose; and there is gradually formed a deposit at the bottom of the cask and on the sides, which frees the wine from every thing not in absolute solution in it, or which is in it in excess. This deposit, called the lees,

fæces, is a confused mixture of tartar principles, analogous to fibrous matter and colouring matter.

But these matters, though deposited in the cask, and precipitated from the wine, are susceptible of being still mixed with it by agitation, change of temperature, &c.; and in that case, besides injuring the quality of the wine, which they render turbid, they may communicate to it a new fermentation, which makes it degenerate into vinegar.

To obviate this inconvenience, the wine is drawn off into other vessels at different periods; all the lees which have been precipitated are carefully separated; and every thing existing in it in a state of incomplete solution is disengaged from it by simple processes, which we shall hereafter detail. By means of these operations it is cleansed and purified, and deprived of all those matters which might determine acetification.

Every thing that relates to the art of preserving wines may be reduced to *sulphuring* and *clarification*.

Sulphuring of Wine.

1st, To sulphur wine is to impregnate it with a sulphurous vapour obtained by the combustion of sulphured matches.

The method of composing these matches varies considerably in different places; some mix with the sulphur aromatic substances, such as powder of cloves, cinnamon, ginger, Florentine iris, flowers of thyme, lavender, marjoram, &c. and melt the mixture in an earthen vessel over a moderate fire. In this melted mixture, rags of cotton cloth are dipped in order to be burnt in the casks. Others employ sulphur alone, which they melt over the fire, and dip rags in it in the same manner.

In the method of sulphuring casks there is also considerable variety. Sometimes the match is suspended at

the end of an iron wire; it is then lighted, and put into the cask intended to be filled with wine; the cask is then stopped, and the match is left to burn: the internal air becomes dilated, and is expelled, with a hissing noise, by the sulphurous gas: two, three, or more matches are burnt in this manner, according as may be thought necessary. When the combustion is terminated, the sides of the cask are scarcely acid; the wine is then poured into it. In other countries, two or three pailfuls of wine are poured into a good cask; a sulphured match is then burnt in it; and when the combustion is finished, the cask is stopped, and shaken in every direction. After being left at rest for an hour or two, it is unstopped, more wine is added; it is then again sulphured, and the operation is repeated till the cask be full. This is the process usually followed at Bourdeaux.

At Marseillan, near the commune of Cette, in Languedoc, a kind of wine is made of white grapes called *mute wine*, which is employed to sulphur others. The vintage is trod and pressed without giving it time to ferment; it is then put into casks filled one-fourth; several matches are burnt over it; and the casks are strongly shaken, until no more gas escapes through the bung-hole when opened. A new quantity of wine is then added, matches are again burnt over it, and the casks are shaken with the same precautions. This operation is repeated till the cask is full. This wine never ferments, and for that reason is called mute wine (*vin muet*). It has a sweetish savour, a strong sulphurous odour, and is employed for mixing with other wine. Two or three bottles of it are put into a cask. This mixture is equivalent to sulphuring.

Sulphuring first renders wine turbid, and gives it a bad colour; but the colour is restored in the course of time, and the wine becomes clear. This operation whitens

the wine a little. Sulphuring is attended with the very valuable advantage of preventing it becoming acetous. Though it be difficult to explain this effect, it appears to me that it cannot be conceived but by considering it under two points of view:

1st, By the help of the sulphurous gas the atmospheric air is displaced, which otherwise would become mixed with the wine, and determine acid fermentation.

2d, Some atoms of a violent acid, which opposes and overcomes the development of a weaker acid, are produced.

The antients composed a kind of mastic with pitch, a fiftieth part of wax, and a little salt and incense, which they employed for burning in their casks. This operation was denoted by the words *picare dolia*, and the wines thus prepared were known under the names of *vina picata*. They are mentioned by Plutarch and Hippocrates.

It was, perhaps, in consequence of this custom, that the fir was consecrated by the antients to Bacchus: at present, an agreeable perfume is communicated to weakened red wine by making it remain over a stratum of the shavings of fir. Baccius says that the casks ought to be pitched (*picare dolia*) during the dog days.

On the Clarification of Wines.

2d, Besides the operation of sulphuring wines, there is another, no less essential, called *clarification*. It consists, in the first place, in drawing off the wine from the lees, which requires certain precautions, and in then disengaging it from all the principles suspended or weakly dissolved in it; so that nothing may be retained but the spiritous and incorruptible principles alone. These operations are even performed before that of sulphuring, which is only a continuation of them.

The first of these operations is called drawing off,

transvasation, defecation. According to Aristotle, this operation ought to be often repeated: *quoniam superveniente æstatis calore solent fæces subverti, ac ita vina acescere.*

In the different wine countries there are certain fixed periods of the year for this operation, established, no doubt, on the constant and respectable observation of ages. At the Hermitage, the wine is drawn off in March and September; in Champagne, on the 13th of October, about the 15th of February, and towards the end of March.

Dry, cold weather is always chosen for this operation. It is certain that it is then only that the wine is in a good condition. Damp weather, and southerly winds, always render wine turbid; and care must be taken not to draw it off while these prevail.

Baccius has left us some excellent precepts respecting the most favourable periods for the defecation of wine. He advises the weakest wines, that is to say, those produced from fat covered soil, to be drawn off at the winter solstice; moderate wines, in the spring; and the most generous, during summer. He gives as a general precept, not to draw off wine but when the north wind prevails; and he adds, that wine drawn off at the time of full moon is converted into vinegar!

The manner of drawing off wine can be a matter of indifference only to those unacquainted with the effect of atmospheric air on that liquid: by opening the tap, or placing a cock at about four inches from the bottom of the cask, the wine which runs off becomes aërated, and determines movements in the lees; so that, under this double view, the wine acquires a disposition to become sour. A part of these inconveniences has been obviated by drawing off the wine by means of a syphon; the motion is then gentler, and by these means one may pene-

trate to any depth at pleasure, without agitating the lees. But all these methods are attended with faults, which have been completely remedied by the help of a pump, the use of which has been established in Champagne and other wine countries.

To a leather pipe, of from four to six feet in length, and two inches in diameter, are adapted at each end wooden pipes, nine or ten inches in length, which decrease in diameter towards the ends, and are fixed to the leather pipe by means of a piece of packthread. The bung of the cask intended to be filled is taken out, and one of the extremities of the pipe is put into it. A good cock is fixed in the cask to be emptied two or three inches from the bottom, and into this is inserted the other extremity of the pipe.

By this mechanism alone, the half of the one cask is emptied into the other: for this purpose nothing is necessary but to open the cock; and the remainder may be made to pass by a very simple process, for which a pair of bellows about two feet in length, comprehending the handles, and ten inches in breadth, are employed. The bellows force the air through a hole formed at the anterior part of the small end: a small leather valve, placed below the small hole, prevents the air from rushing out when the bellows are opened, and to the extremity of the bellows is adapted a perpendicular wooden pipe to convey the air downwards: this tube is fitted into the bunghole in such a manner, that when the bellows are worked and the air forced out, a pressure is exercised on the wine, by which means it is obliged to issue from the one cask, and to ascend into the other. When a hissing is heard at the cock, it is speedily shut: this is a sign that all the wine has passed.

Funnels of tin plate, the tubes of which are at least a foot and a half in length, that they may be immersed in

the liquor without causing any agitation, are also employed.

Drawing off wine separates a part of its impurities, and consequently removes some of those causes which may alter the quality of it: but there still remain some suspended in the liquor, which cannot be caught but by the following operations, which are called *fining* of wine, or *clarification*: Fishglue (isinglass) is almost always employed for this purpose: it is unrolled with care, and cut into small morsels, and it is then steeped in a little wine, where it swells up, becomes soft, and forms a viscid mass, which is poured into the wine. The wine is then strongly agitated, after which it is left at rest. Some whip the wine, in which the glue has been dissolved, with a few twigs of birch, &c. and by these means occasion a considerable foam, which is carefully removed. In all cases a portion of the glue is precipitated with the principles it has enveloped, and the liquor is drawn off when the deposit is formed.

In warm climates the use of glue is dreaded, and during summer its place is supplied by whites of eggs: ten or twelve are sufficient for half a *muid**. The eggs are first beat up with a little wine; they are then mixed with the liquor intended to be clarified, and it is whipped with the same care. It is possible that gum arabic might be substituted for glue. Two ounces will be sufficient for four hundred pots of wine. It is put into the liquor in the form of a fine powder, and the liquor is then stirred.

Wine must not be drawn off till it is completely made: if the wine is green and harsh, it must be suffered to ferment a second time on the lees, and must not be drawn off till towards the middle of May; if it continues green, it may even be left till the end of June. It even sometimes happens that it is necessary to convey back the wine to

* About a 72 gallon cask English.

the lees, and to mix them strongly, that the wine may again acquire that movement of fermentation which is necessary to bring it to perfection.

We are told by Miller that when Spanish wine becomes turbid by the lees, it may be clarified by the following process: Put the whites of eggs, gray salt, and salt water, into a convenient vessel; skim off the foam formed at the surface, and pour the composition into the wine cask from which a part of the liquor has been drawn off: at the end of two or three days the liquor becomes clear, and acquires an agreeable taste. After being suffered to remain at rest for about a week, it is then drawn off.

To revive claret injured by floating lees, two pounds of calcined flints, well pounded, ten or twelve eggs, and a large handful of salt, are beat up with two gallons of wine, which are then poured into the cask: two or three days after, the wine is drawn off.

These compositions may be varied without end: sometimes starch is employed, and also rice, milk, and other substances, more or less capable of developing the principles which render the wine turbid.

Wine is clarified also, and its bad taste is often corrected, by making it digest over shavings of beech wood, previously stripped of the bark, boiled in water, and dried in the sun or in a stove: a quarter of a bushel of these shavings will be sufficient for a *muid* of wine. They produce a slight movement of fermentation in the liquor, which becomes clear in the course of twenty-four hours.

The art of *cutting wines* (couper du vin), as it is called, (correcting one wine by another—giving a body to those wines which are weak—colour to those destitute of it—and an agreeable flavour to those which have none, or which have a bad one,) cannot be described. In these cases, the taste, sight, and smell must be consulted. The highly variable nature of the substances employed must be studied; and it will be sufficient for us to observe,

that in this part of the management of wines every thing consists: 1st, In sweetening wines, and rendering them saccharine by the addition of *baked must*, concentrated with honey, sugar, or another wine of a very luscious quality. 2d, Colouring the wine by an infusion of turnsole cakes, the juice of elder-berries, logwood, and mixing it with dark, and, generally, coarse wine. 3d, Perfuming it by syrup of raspberries, an infusion of the flowers of the vine suspended in the cask, tied up in a bag, as is practised in Egypt, according to the testimony of Hasselquist.

In the Orleanois, and other countries, a wine is made called there *vin rapé*. It is prepared from picked grapes, which are trod with wine or ley; placing in the press a stratum of vine-twigs and another of grapes in alternate order, or by infusing the twigs in the wine. These wines are made to boil strongly, and they are then employed to give strength and colour to the weak colourless wines of the cold and damp countries.

Though wine may work at all times, there are certain periods of the year at which fermentation seems to be renewed in a particular manner; and, above all, when the vine begins to bud, when it is in flower, or when the grapes begin to become coloured. At these critical moments, wine ought to be watched with particular care; and every movement of fermentation may be prevented by drawing off, and sulphuring it, as above indicated.

When wines are completely clarified, they are preserved in casks, or in glass. The largest vessels are the best, and they ought to be well closed. Every body has heard of the enormous capacity of the tun of Heidelberg, in which wine is preserved for whole centuries, always improving in quality; and it is allowed that wine keeps better in very large casks than in small ones.

The choice of situation in which vessels containing wine ought to be deposited, is not a matter of indifference : on this subject we find among the antients usages and precepts which deviate for the most part from our common methods, but which, in part, are worthy of attention. The Romans drew off the wine from the casks to shut it up in large earthen vessels glazed in the inside : this is what they called *diffusio vinorum.* It appears that for containing wines they had two sorts of vessels, which they called *amphora* and *cadus.* The *amphora* was of a square or cubical form, had two handles, and contained twenty gallons of liquor. This vessel terminated in a narrow neck, which was stopped with pitch or plaster to prevent the wine from exhaling. This we learn from Petronius, who says, *Amphoræ vitreæ diligenter gypsatæ allatæ sunt, quarum in cervicibus pittacia erant affixa cum hoc titulo* —" *Falernum opimanum annorum centum..*" The *cadus* had the figure of the cone of a fir-tree ; it contained one-half more than the *amphora.*

The most generous wines were exposed to the open air in vessels well closed; the weakest were prudently placed under cover : *Fortius vinum sub dio locandum, tenuia vero sub tecto reponenda, cavendaque a commotione ac strepitu viarum,* says Baccius. Galen observes that the whole wine was put into bottles, after which it was exposed to a strong heart in close apartments ; and in summer it was exposed to the sun on the tops of the houses, that it might sooner become mellow, and fit for drinking. *Omne vinum in lagenas transfundi, postea in clausa cubicula multâ subjecta flammâ reponi, et in tecta ædium æstate insolari, unde citius maturescant ac potui idonea evadant.*

That wine may keep, and improve in quality, it ought to be put into vessels deposited in proper places, the choice of which is not a matter of indifference. Glass

vessels are the most favourable, because, besides their presenting no principle soluble in wine, they shelter it from the contact of the air, from moisture, and the principal variations of the atmosphere. Care must be taken to shut these vessels very closely with good cork; and to lay the bottles on their sides, that the cork may not dry, and facilitate the access of the air. For the greater safety, the cork may be covered with a coating of wax, applied by means of a brush; or the neck of the bottle may be immersed in a mixture of melted wax, resin, and pitch. Some people cover the wine with a stratum of oil; this process is recommended by Baccius. The neck is then covered with an inverted glass tumbler, a vessel of tin plate, or any matter capable of preventing insects or mice from falling into the wine.

The vessels most generally employed for keeping wine are casks, which for the most part are made of oak. They vary in size, and are known by different names, such as pipes, hogsheads, &c. The great inconvenience of casks is, that they not only present to the wine substances which are soluble in it, but that they are affected by the variations of the atmosphere, and afford a passage both to the air which endeavours to escape from them, and to that of the atmosphere which penetrates them.

Glazed earthen vessels have the advantage of retaining a more equal temperature; but they are more or less porous, and at length the wine in them must become dry. In the ruins of Herculaneum vessels were found in which the wine had dried. Rozier speaks of a similar urn discovered in a vineyard in the territory of Vienne in Dauphiny, in a place where the palace of Pompey had formerly stood. The Romans remedied the porosity of earthen vessels by covering them with wax on the inside, and pitch on the outside: they covered also the whole surface with wax cloths, which they applied with great care.

Pliny condemns this use of wax, because, he says, it made the wine turn sour : *Nam ceram accipientibus visis, compertum est vina acescere.*

Whatever may be the nature of the vessels destined to contain wine, a celler sheltered from all accidents must be chosen.

1st, The exposure of the cellar must be northern : its temperature is then less variable than when the apertures are turned towards the south.

2d, It must be of such a depth that the temperature may be constantly the same. *In cellis quæ non satis profundæ sunt diurni caloris participes fiunt ; vina non diu subsistunt integra,* says Hoffman.

3d, The moisture in it must be constant, without being too great : excess of moisture renders the papers, corks, casks, &c. mouldy. Dryness desiccates the casks, and makes them leak.

4th, The light ought to be very moderate : a strong light dries ; darkness, almost absolute, rots.

5th, The cellar must be sheltered from shocks. Violent agitation, or that shaking occasioned by the rapid passage of carriages along the street, agitates the lees, mixes them with the wine, where they are kept suspended, and occasions acetification. Thunder, and all movement occasioned by shocks, produce the same effect.

6th, Green wood, vinegar, and all substances susceptible of fermentation, must be kept at a distance from a cellar.

7th. The reverberation of the sun, which, as it necessarily changes the temperature of a cellar, must also alter the properties of the wine preserved in it, ought also to be guarded against.

A cellar, therefore, must be dug to the depth of some fathoms below ground ; its apertures ought to be directed towards the north ; it must be at a distance from the street,

highways, workshops, sewers, necessaries, &c. and ought to be arched at the top.

VII. Maladies of Wine, and the Means of preventing or correcting them.

There are some wines which improve by age, and which cannot be considered as perfect till a long time after they have been made. Luscious wines are of this kind, as well as all highly spiritous wines; but delicate wines are so apt to turn *sour*, or *oily*, that it is only by means of great precaution they can be preserved for several years.

The first of the principal kinds of wine known in Burgundy, is that of Volney, near Beaune. This wine, so delicate and agreeable, will not bear the vat above 12, 16, or 18 hours, and can scarcely be kept from one vintage to another.

The second of the principal kinds of wine in Burgundy is that of Pomard: it keeps better than the former; but if kept longer than a year, it becomes oily, spoils, and assumes the colour of the peelings of onions.

In every canton the wine has a fixed and known period of duration; and it is every where known that this period must be shorter or longer according to the nature of the season, and the care employed in the process of vinification. No one is ignorant that the wine made from grapes collected in rainy weather, or produced in fat soil, is not of long duration.

The antients, as we are informed by Galen and Athenæus, had determined the epoch of age, or the period at which the different wines ought to be drunk:—Falernum *ab annis decem ut potui idoneum, et a quindecim usque ad viginti annos:* after that period *grave est capiti et nervos offendit.* Albani *vero cum duæ sint species, hoc dulce illud acerbum, ambo a decimo quinto anno vigent.* Sur-

rentinum *vigesimo quinto anno incipit esse utile, quia est pingue et vix digeritur, ac veterascens solum sit potui idoneum.* Tiburtinum *leve est, facile vaporat, viget ab annis decem.* Lubicanum *pingue et inter albanum et falernum putatur usui ab annis decem idoneum.* Gauranum *rarum invenitur, at optimum est et robustum.* Signimum *ab annis sex potui utile.*

The care employed in drawing off wine, and mixing it with *mute* wine, contributes greatly to its preservation. Few kinds are shipped without this precaution. It is of importance then, for the prevention of all its alterations, that all these operations should be multiplied and repeated; and it is to this valuable practice we are indebted for the power of being able to send wine to all climates, and to subject it to all temperatures, without fear of decomposition.

Among the diseases to which wines are most subject, *oiliness* and *acidity* are the most common and most dangerous.

Oiliness is an alteration which wines often contract: they lose their natural fluidity, and become ropy, like oil.

The less spiritous wines turn oily; and weak wines, which have fermented very little, are the most disposed to this malady. Weak wines, made from grapes which have been picked, are also subject to it.

Wine turns oily in the best corked bottles. Of this there are too frequent instances in Champagne, where the wine of a whole vintage, when put into glass vessels, is exposed sometimes to this alteration.

Oily wines furnish by distillation but a little fat coloured and oily spirit.

This fault may be corrected several ways.

1st, By exposing the bottles to the air, and, above all, in a well-aired barn.

2d, By shaking the bottle for a quarter of an hour; then uncorking it, and suffering the gas and foam to escape.

3d, By mixing the wine with fish-glue and whites of eggs mixed together.

4th, By introducing into each bottle one or two drops of lemon juice, or any other acid.

From the nature of the causes which produce oiliness in wines, the phænomena exhibited by that malady, and the means employed to cure it, it is evident that this alteration arises from the extractive principle, which has not been sufficiently decomposed.

We find a similar effect in beer, in the decoction of gall-nuts, and in several other cases where the extractive matter, being very abundant, is precipitated from the liquor which held it in solution; and acquires the characters of fibrine matter, unless burned by a fermentation or precipitated by an acid.

Acescence of wine is however the most common malady, and, we may even say, the most natural, for it is almost a consequence of spiritous fermentation; but by knowing the causes which produce it, and the phænomena which accompany or announce it, means may be taken to prevent it. The antients admitted three principal causes of the acidity of wines:—1st, The humidity of the wine: 2d, The inconstancy or variations of the atmosphere: 3d, Commotions.

To know this malady exactly, we must call to mind some principles which can alone furnish us with light on this subject.

1st, Wine never turns sour until the spiritous fermentation is terminated; or, in other words, till the saccharine principle is completely decomposed. Hence the advantage of putting wine into casks before all the saccharine principle has disappeared; because the spiritous fermentation then continues, is prolonged, and removes every

thing that can pave the way for acetous decomposition. Hence the practice of putting a little sugar into the bottle to preserve the wine without alteration; and hence the very general method of baking a part of the must at a slow and moderate heat, and of mixing some of it in the casks intended for embarkation. In some places of Spain and Italy all the must is baked; and Bellon says that the wines of Crete would not keep at sea unless the precaution were taken to boil them.

2d, The least spiritous wines are those which soonest become sour. We know, by experience, that when the season is rainy, if the grapes be little saccharine, which consequently give little alcohol, the wines readily turn sour. The weak wines of the north become sour with great ease; while the strong, generous, spiritous wines obstinately resist acidity.

It is however no less true, that the most spiritous wines furnish the strongest vinegar, though their acetification is more difficult, because alcohol is necessary to the formation of vinegar.

3d, Wine perfectly free from all extractive matter, either in consequence of its being deposited naturally by time or by clarification, is not susceptible of turning sour. I have exposed old wine in uncorked bottles to the ardour of the sun of July and August for more than forty days without the wine losing its quality; only the colouring principle was constantly precipitated under the form of a membrane, which covered the bottom of the bottle. The same wine in which I infused vine-leaves, became sour in a few days. It is known that old wines, well purified, do not turn sour.

4th, Wine does not acidify, or become sour, but when in contact with the air: atmospheric air mixed with wine is a real leaven of acidity. When wine grows flat (*se pousse*) it suffers to escape, or exhales, the gas it contains, and the external air then enters to assume its place.

Rozier proposes to adapt a bladder to a pipe inserted in the vessel, in order to ascertain the absorption of the air and the disengagement of the gas. When the bladder fills, the wine tends to flatten; if it empties itself, it is a sign of its turning sour.

When wine flattens, the cask suffers the wine to ooze through the sides, and if a hole be made with a gimblet, the wine escapes with a hissing noise and foam: on the other hand, when wine turns sour, the sides of the cask, the bung, and the luting, are dry, and the air rushes in with violence as soon as it is unstopped.

From this circumstance it may be concluded that wine shut up in very close vessels is not susceptible of becoming sour.

5th, There are certain times of the year when the wine turns more readily sour. These periods are, the moment when the sap rises in the vine, when it flowers, or when the grapes assume a reddish tint. It is during these periods, in particular, that precautions must be taken to prevent its becoming acid.

6th, Change in the temperature also promotes acidity, especially when the heat rises to 80 or 90 degrees. The degeneration is then rapid, and almost unavoidable.

The acidity of wine may be easily prevented by removing all those causes before mentioned which tend to produce this alteration; and when it has begun, it may be remedied by the means, more or less effectual, which we are going to mention.

Baked must, honey, or liquorice, are dissolved in wine in which acidity has manifested itself: by these means its sour taste is corrected, being concealed by the sweetish savour of these ingredients.

The little acid which has been formed may be seized by the means of ashes, alkalies, chalk, lime, and even litharge. This last substance, which forms a very sweet

salt with acetous acid, is exceedingly dangerous. This criminal adulteration may be easily detected by pouring hydro-sulphuret of potash (liver of sulphur) into the wine. There will be immediately formed an abundant and black precipitate. Sulphurated hydrogen gas may also be made to pass through this altered liquor: this will produce a blackish precipitate, which is nothing but sulphuret of lead.

The works of oinologists abound with recipes, of greater or less value, for correcting the acidity of wine.

Bidet says, that about a fiftieth of skimmed milk added to sour wine restores it; and that it may be drawn off in five days.

Others take four ounces of the best wheat, boil it in water till it bursts; and, when it has cooled, put it into a small bag which is immersed in the cask, shaking it with a stick.

Some recommend also the seeds of leeks, fennel, &c.

To show the futility of the greater part of these remedies, it will be sufficient to observe, that it is impossible to make fermentation proceed in a retrograde manner, and that it can at most be suspended; that the whole of the acid then formed may be seized, or its existence may be concealed, by sweet and saccharine principles.

But besides these alterations there are others, which, though less common and dangerous deserve to be noticed. Wine sometimes contracts what is called a taste of the cask. This malady may arise from two causes: first, when the wine is put into casks, the wood of which is rotten or damaged; secondly, when lees have been left to dry in the casks into which new wine is put. Willermoz proposes lime water, carbonic acid, and oxygenated muriatic acid, to correct the bad taste arising from the cask: others recommend mixing the wine with isinglass, drawing it carefully off, and infusing roasted wheat in it for two or three days.

A phænomenon, which has struck and embarrassed the numerous authors who have spoken of the diseases of wine, is what is called the *flowers of wine.* These are formed in casks, but particularly in bottles, in which they occupy the neck; they constantly announce and precede the acid degeneration of wine. They manifest themselves in almost all fermented liquors, and always more or less abundantly according to the quantity of extractive matter existing in the liquor. I have seen them formed in such abundance, in a fermented mixture of molasses and the yeast of beer, that they precipitated themselves in the liquor in pellicles, or numerous and successive strata. In this manner, I have obtained twenty strata.

These flowers, which I at first took for a precipitate of tartar, is, in my opinion, a vegetation, or real *byssus,* which belongs to that fermented substance. It is reduced almost to nothing by desiccation, and by analysis exhibits only a little hydrogen and a great deal of carbon.

All these rudiments or commencements of vegetation, which develope themselves in all cases where an organic matter is decomposed, ought not, in my opinion, to be classed with perfect plants: they are not susceptible of reproduction, and are only a symmetric arrangement of the moleculæ of the matter, which seems rather directed by the simple laws of affinity than those of life. Similar phænomena are observed in all decompositions of organic beings.

In the years 1791 and 1792, the whole product of the vintage was altered at the commencement by an acrid, nauseous odour, which went off after a long-continued fermentation. This effect was owing to an enormous quantity of tree-bugs, (*punaises de bois,*) which had settled on the grapes, and which had been crushed in treading them.

VIII. Uses and Virtues of Wine.

Wine has become the most usual beverage of man, and is, at the same time, the most varied. Wine is known in all climates; and the attraction of this liquor is so strong, that the prohibitory law respecting it, which Mahomet imposed on his followers, is daily broken.

This liquor, besides being a tonic and strengthener, is also more or less nutritive: in every point of view, it must be salutary. The antients ascribed to it the property of strengthening the understanding. Plato, Æschylus, and Solomon, all agree in ascribing to it this virtue. But no writer has better described the real properties of wine than the celebrated Galen, who assigns to each sort its peculiar uses, and describes the difference they acquire by age, climate, &c.

Excess in regard to the use of wine has at all times called forth the censure of legislators. It was customary among the Greeks to prevent intoxication by rubbing their temples and forehead with precious ointments and tonics. The anecedote of that famous legislator, who, to restrain the intemperance of the people, authorized it by an express law, is well known; and we read that Lycurgus caused drunken people to be publicly exhibited, in order to excite a horror of intoxication in Lacedæmonian youth. By a law of Carthage, the use of wine was prohibited in the time of war. Plato interdicted it to young persons below the age of twenty-two. Aristotle did the same to children and nurses. And we are informed by Palmarius that the laws of Rome allowed to priests, or those employed in the sacrifices, but three small glasses of wine at their repasts.

But, notwithstanding the wisdom of laws, the hideous picture of intemperance, and the fatal consequences with which it is attended, the attractions of wine have been so powerful among certain nations, that their fondness for it

has degenerated into a passion and real want. We daily see men, prudent in other respects, gradually acquire the habit of indulging immoderately in the use of this liquor; and in their wine extinguish their moral faculties and their physical strength.

Narratur et prisci Catonis,
Sæpe mero incaluisse virtus.

We learn from history, that Wenceslas, king of Bohemia and of the Romans, having come to France to negotiate a treaty with Charles VI. repaired to Rheims in the month of May 1397, where he got intoxicated every day with the wine of the country, choosing rather to forego every thing than not indulge in this excess*.

The virtue of wine differs according to its age. New wine is flatulent, indigestible, and purgative: *mustum flatuosum et concoctu difficile. Unum in se bonum continet, quod alvum emolliat. Vinum rarum infrigidat;—mustum crassi succi est, et frigidi.*

The antients confounded these words—*mustum et novum vinum.* Ovid says, *Qui nova musta bibant. Unde virge musta dicta est pro intacta et novella.*

Light wines only can be drunk before they have grown old. The reason we have mentioned in the preceding pages. The Romans, as we have observed, followed this custom, and drank their wines in succession: *Vinum Gauranum et Albanum, et quæ in Sabinis et in Tuscis nascuntur, et Amienum quod circa Neapolim vicinis collibus gignitur.*

New wines are not at all nourishing, especially those which are aqueous, and little saccharine: *corpori alimentum subgerunt paucissimum,* says Galen.

These wines readily produce intoxication; and the reason of this is, the qnantity of carbonic acid with which

* Observations sur l'Agriculture, vol. ii. p. 192.

they are charged. This acid, by disengaging itself from the liquor by the temperature of the stomach, extinguishes the irritability of the organs, and brings on stupor.

Old wines, in general, are tonic, and very wholesome: they are suited to weak stomachs, old people, and in all cases where strengthening is necessary: they afford very little nourishment, because they are deprived of their really nourishing principles, and contain scarcely any other than alcohol.

It is of such wine that the poet speaks, when he says:

——— Generosum et lene requiro
Quod curas abigat, quod cum spe divite manet
In venas animumque meum, quod verba ministret,
Quod me, Lucane, juvenem commendet amicæ.

Oily thick wines are the most nourishing. *Pinguia sanguinem augent et nutriunt*;—Galen. The same author recommends the wines of Therea and Scibellia as highly nourishing: *quod crassum utrumque, nigrum et dulce.*

Wines differ also essentially in regard to colour. Red, in general, is more spiritous, lighter, and more digestible: white wine furnishes less alcohol, and is more diuretic and weaker, as it has remained less time in the vat: it is almost always more oily, more nutritive, and more gaseous, than the red.

Pliny admits four shades in the colour of wines—*album, fulvum, sanguineum, rubrum:* but it would be too minute as well as useless to multiply shades, which might become infinite, by extending them from black to white.

Climate, culture, and variety in the processes of fermentation, produce also infinite differences in the qualities and virtues of wine. To avoid fatiguing repetitions, we must refer to what we have already said on this subject.

The art of tempering wine by the addition of one part of water was practised among the antients: wine of this kind they called *vinum dilutum.* Pliny, after Homer, speaks of a wine which could bear twenty parts of water. The same historian informs us, that in his time wines so spiritous were known, that they could not be drunk: *nisi pervincerentur aqua et attenuentur aqua calida.*

The antients, who had very just and correct ideas respecting the art of making and preserving wines, seem to have been unacquainted with that of distilling spirit from them: the first correct ideas respecting the distillation of wine are ascribed to Arnaud de Villeneuve, professor of medicine at Montpellier.

The distillation of wines has given a new value to this production. It has not only furnished a new beverage stronger and incorruptible, but has made known to the arts the real solvent of resins and of aromatic principles, and, at the same time, a mean as simple as certain for preserving animal and vegetable substances from all putrid decomposition. It is on these remarkable properties that the art of the varnisher, the perfumer, the maker of liqueurs, and others founded on the same basis, have been successively established.

No. 52.

(With a Plate.)

*A Mode of conveying Intelligence from a reconnoitring party. In a letter from a correspondent, to W. Nicholson, Esq.**

Sir—I herewith send you a model, which I denominate a *Hippograph,* and which appears to me likely to be of use in the march of troops, &c.

It may consist of any number of men and officers, but

* Nicholson, V. 30. p. 126.

I conceive an officer and six men quite sufficient. The use it seems most adapted to is, when a mountain or high ground is in front, and it is wished by the commanding officer to know what may be on the other side, by dispatching such a number of men intelligence can be at once conveyed by changing the front of one or more men to express numbers or permanent signals, as agreed on, as the boards of a telegraph; and by the officer placing himself on either flank, centre, or rear, the numbers would be quadrupled. I know by experience it may be distinguished at a great distance. Should you think this worthy of notice, it will be a satisfaction to, sir, your obedient servant,

H. I. B.

August, 1811.

The model consists of little tin casts of six horse soldiers and one officer, see Pl. 12, Fig. 10. These are placed on a slip of wood, and each is moveable on a pivot, so that it may be turned into any position.

No. 53.

(With a Plate.)

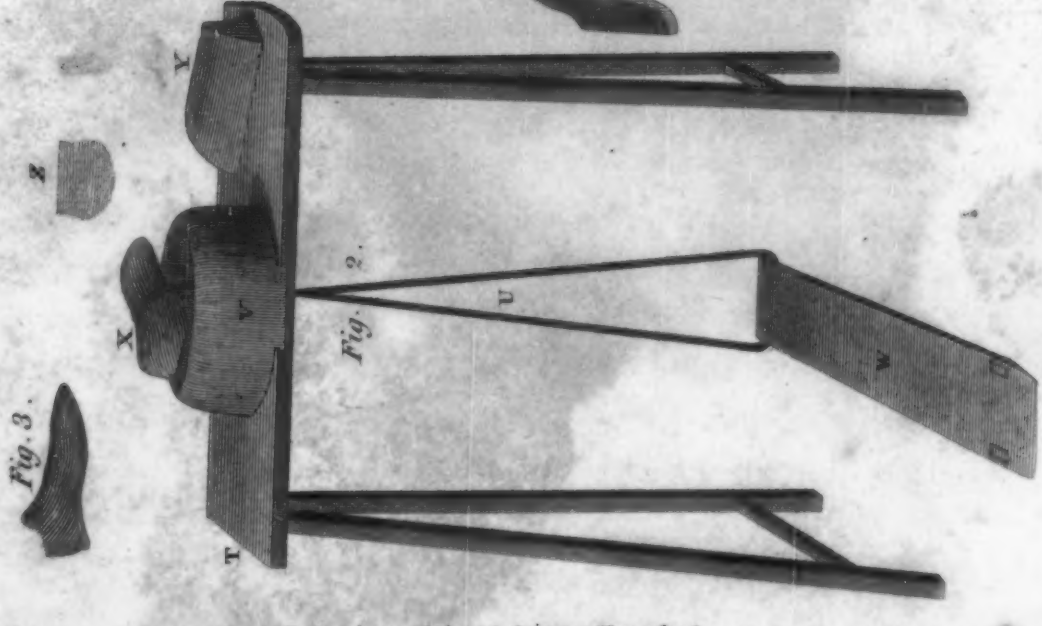
Account of a Machine for performing the Thread-Work in Shoe-making in a standing Posture; contrived, and for many Years constantly used by Thomas Holden, *Shoemaker, of Fettleworth, near Petworth, Sussex.**

A very moderate observation of the different processes of handicraftsmen will shew how extremely various are their habits of manipulating. Every different position of standing, sitting, and, perhaps, lying, may be found among them; and in works apparently of the same na-

* Nicholson, v. 14. p. 155.—For which the Society of Arts gave a premium of fifteen guineas. See vol. xxii. of their Transactions. One of the machines is in their Repository.

Holdens Machine for Shoemakers.

Parkers Machine for Shoemakers.



Emporium of Arts & Sciences V. 1. pl. 13.

Tiebout & Kearny

ture, the positions are found to be considerably unlike each other. It is probable that the first workman assumed positions which, whether aukward, confined, or inconsistent with health, or the contrary, came into universal use when the habit of the individual and the confirmed custom of master and apprentice had given them the sanction of many years. Thus we see that men's cloths are sewed by men who sit cross-legged; women's cloths by women who sit in no unusual position: turners in India hold the tool with their feet, and turn the lathe with the left hand, while they sit on the ground with the body leaning very much forward; in Europe they stand and turn with one foot, while the hand directs the tool: comb-cutters, for coarse or open-toothed combs, sit astride a large triangular stool with their work as low as the seat, so that they must keep their bodies almost horizontal while at work; but those who cut ivory combs sit very nearly upright.

Many other examples might be given, not only of works which are practically shewn to be capable of being executed with less injury to the comfort and health of the professors than at present; but of others where the mischiefs are no less evident, and their remedies by no means difficult, if man could be, by the gentle influence of reason, induced to depart from what habit has confirmed and made easy.

The numerous bodily complaints which are consequent to the practice of the art of shoe-making, as now performed, are well known to all; and the remedies in this, as well as other branches of human industry, are intitled to general regard. He who improves the cultivation of the ground, or renders human labour more productive by machinery, is intitled to universal gratitude as a benefactor of the human race: He increases their comforts, and renders the means of subsistence more easy. The same

argument will apply to every man who by his ingenuity or his influence shall diminish the evils which may be ultimately attendant on a life of labour. Thomas Holden has been impelled, for his own personal relief, to construct and use a simple machine for one branch of his craft. The master shoemakers and their masters, or employers, will act meritoriously in extending its use. As the editor of a Journal of *the Arts*, I have thought it my duty in this, as in most other instances, to second the views of that excellent Society, which has been so long established in London, and has so actively and constantly exerted itself for their encouragement.

Mr. Nicholas Turner, who addressed the Society on behalf of this machine, speaking highly in its commendation, says that its cost will not be more than from between twenty and thirty shillings. The inventor himself, after stating his sufferings from the pursuit of his business as a maker of shoes, says that he has found it to answer, and its use to have been followed by a restoration of his health. When he wrote his letter, he had made about two thousand pair of shoes with it, and he considers it as the quickest way of closing all the thread-work.

Certificates were also sent to the Society, from six cordwainers of the vicinity, who were witness to the use and advantages of the machine; and Mr. Peter Martin, Surgeon, of Tulborough, wrote a letter to Charles Taylor, Esq. secretary to the Society, which I have extracted verbatim.

"I am sincerely of opinion, that Thomas Holden's in-
"vention is a desirable acquisition to men of that profes-
"sion, especially to those who may be diseased internal-
"ly, or who may suffer from stomach weakness and in-
"digestion. These diseases may be aggravated, if not
"occasioned, by their working in a bent posture.

"The inventor, about twenty years ago, often applied

"to me for relief from a train of bowel complaints, and "frequently had occasion to take the medicines usually "employed for the relief of dyspepsia.

"I repeatedly informed him, that his employment was "the cause of his disorder, and desired him to relinquish "it, or invent some method to do his work standing. This "hint, and his corporeal sufferings, prompted to the in- "vention. That it answers the purpose, I have reason "to believe, as he and others use it. He is now free of "complaints, and so improved in his corpulence and "countenance, that he is not like the same man, and for "years has had no occasion for medicine."

Reference to the Engraving of Mr. Holden's Invention for Shoemakers, Pl. 13, Fig 1.

A. The bed for the closing block, and to lay the shoe in whilst sewing.

B. The closing block.

C. A loose bed to lay the shoe in whilst stitching; the lower part of which is here exhibited reversed, to show how it is placed in the other bed, A.

D. The hollow or upper part of the loose bed C, in which the shoe is laid whilst stitching.

E. A table on which the tools wanted are to be laid.

F. An iron semicircle, fixed to each end of the bed A, to allow the bed to be raised or depressed. This half circle moves in the block G.

H. Another iron semicircle, with notches, which catch upon a tooth in the centre of the block, to hold the bed in any angle required. This semicircle moves sideway on two hooks in staples, at each end of the bed.

I. The tail or stem of the bed A, moving in a cylindrical hole in the pillar, enabling the bed to be turned in any required direction, and which, with the movement F,

enables the operator to place the shoe in any position necessary.

K. The pillar, formed like the pillar of a claw table, excepting the two side legs being in a direct line, and the other leg at a right angle with them.

L. The semicircle H, shown separately, to explain how it is connected with the staples, and how the notches are formed.

M. The tail or stem of the bed A, and the lower part of the bed N, shown separately, to explain how the upper part of the bed is raised or depressed occasionally.

No. 51.

Description of a Machine for the use of Shoemakers. By Mr. Thomas Parker*.

(With a Plate.)

MR. Thomas Parker, the inventor of the machine, was desired to attend with it upon a committee appointed by the Society of Arts, on the 22d of November, 1804, and then informed them, that he had used this apparatus for twelve months past, and found it very useful. That all the work of shoe-making may be done with it standing; but that in some parts thereof he finds an advantage in using along with it a high stool; and that before he used this machine, he never saw or heard of a similar invention; and that he has found it of great service to his health.

He stated the cost of such a machine to be about two guineas.

Plate 13. Fig. 2.——T. A bench standing on four legs, about four feet from the ground.

* Nicholson vol. 15. p. 165.—Communicated to the Society of Arts, who gave a premium of fifteen guineas.

V. A circular cushion affixed to the bench, in the centre of which cushion is an open space quite through the bench, through which hole a leather strap U is brought up from below. This strap holds the work and last firm upon the cushion in any position required, by means of the workman's foot place upon the treadle W.

X, Shows the last upon the cushion, with the strap holding it firm.

Y, An implement used in closing boots.

Z, A small flat leather cushion, useful in adjusting the last and strap.

Fig. 3. The shoe-last shown separate from the cushion. The round cushion is formed of a circular piece of wood, covered with leather or stuffed with wool or hair to give it some elasticity.

No. 55.

Description of an improved File for Receipts and Letters. By RICHARD WHITE, *Esq. of Essex-Street*.*

(With a Plate.)

SIR, I send herewith the model of a file for papers, which I think will be found preferable to any in common use. A voucher cannot be disengaged from the common file, without defacing it by cutting it off, or by removing many others to get at it; and to return it to its proper place is attended with more trouble and inconvenience. All this is avoided by the contrivance in the file now sent, the wire of which is passed through a cylinder, and fastened by a screw at the bottom.

I am, Sir, your very humble servant.

RICHARD WHITE.

* Nicholson. v. 25. p. 330.—Transact. of the Society of Arts, vol. xxvii, p. 170. The silver medal was voted to Mr. White for this invention.

Explanation of Mr. White's improved Letter File, as shown in Plate XII, Figs. 3, 4, 5, 6,

This invention consists of a metal tube *a*, fig 4, with a convex circular plate soldered to its lower end, to keep the papers from slipping off the file, and having attached to its under side a piece of metal *b*, fig. 5, with a screwed hole in it, to receive a screw on the end of the wire, *c*, fig. 6, the other end of the wire being formed into a hook, sharpened at its point, to receive the papers as usual.

When any paper is wanted to be taken off the file, (instead of taking off those above it, which cannot be replaced again without much loss of time and trouble, or, which is still worse, tearing it off) the uppermost papers are to be slipped up towards the top of the wire *c*, which must be unscrewed, and, with the papers upon it, removed, as shown in fig. 6; the paper wanted may then be taken away, the wire replaced again into its tube *a*, and screwed fast, and the other papers drawn down the tube as before. The upper end of the tube *a* should be made conical, and its edges sharp, the better to suffer the papers to pass over it. A section of the tube and female screw *b* beneath is shown separately at fig. 5. The papers are shown in fig. 3, in the situation they are commonly placed upon the cylinder, with the wire within the cylinder.

No. 56.

Description of Mr. DAVIS'S *improved Machine for Painters and Glaziers*.*

(With a Plate.)

THE frequent accidents which happen to painters and glaziers, from the unsteadiness of their machines, and the

* Nicholson v. 19. p. 13.—From the Trans. of the Society of Arts for 1806, p. 138.

Davis' Machine for Glaziers.

Fig. 7.

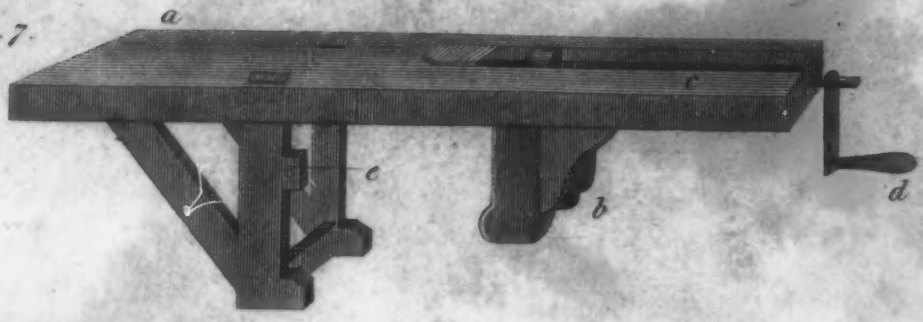
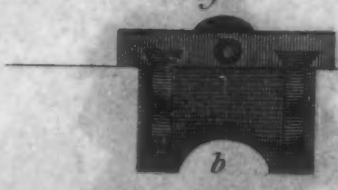


Fig. 9.

Fig. 8.



Wilkins' improved Nostrils Apparatus.

White's improved Letter File.

Fig. 1.

Fig. 2

Fig. 6.

Fig. 3.

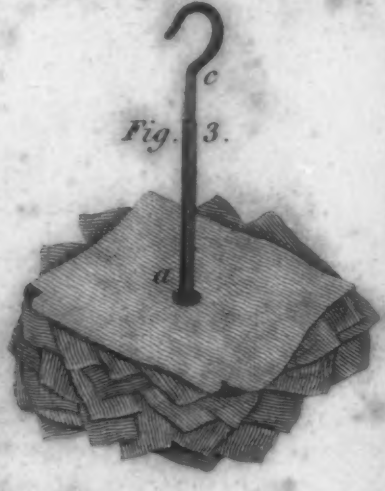


Fig. 5.

Fig. 4.

Hippograph.

Fig. 10.

Emporium of Arts & Sciences Vol. 1. pl. 12.

Tisbout V. Kearney.

consequent misery brought upon their families, stimulated Mr. Joseph Davis, of the Crescent, Kingsland Road, to endeavour at their improvement. The result was the machine delineated in Plate 12, which may be made perfectly firm and secure, without occasioning any injury to the wainscoting or paint. In those cases however, where the bottoms of the windows are flush with the floor, as is usual in the best apartments of modern houses, neither the common machine, nor this with the improvement intended for general use, can be applied: but Mr Davis has contrived an additional piece to be used on such occasions, which renders it equally secure.

Fig. 7, Plate 12, Represents the machine: the part *a* is similar to that used by glaziers, which is placed on the outside of the window. *b*, is an additional moving piece, which presses against the inside of the window frame, and is brought nearer to, or removed farther from it, by means of the male screw *c*, and its handle *d*.

Fig. 8, Shows the lower part of a window, and the manner in which the moving piece *b*, including a female screw, acts against the inside of the window frame.

Fig. 9, Shows a cross bar introduced in place of the moving piece last mentioned, which bar extends from one window side to the other, and explains how the machine may be used, where any injury might arise from screwing the moving piece in the centre of the recess of the window.

The general improvement consists in the use of a screw on that end of the frame which is within the house, and which keeps the machine steady and firm, instead of the two upright irons, which are put through holes made in the top plank of the machine, in the coommon mode, and which occasion the machine to be very unsteady in use, and liable to accident. There are two blocks marked *e*, *e*, in Fig. 4, which may be occasionally put in, or taken out, according as the stone work under the window may require.

No. 57.

Agenda, or a Collection of Observations and Researches, the Results of which may serve as the Foundation for a Theory of the Earth. By M. De Saussure.

(Concluded from page 343.)

CHAP. XXI.

Researches to be made in regard to the Loadstone.

1. THE theory of the loadstone ought to form a part of the theory of the earth, because the phenomena which depend on it belong to the whole globe; and because Halley, and after him other philosophers, have endeavoured to explain the different phenomena of the magnet by supposing the earth to be hollow, and that it contains in its cavity one or more magnetic globes.

2. In considering the loadstone it ought first to be examined whether, in order to explain its phenomena, we ought, like Descartes, to suppose a close fluid moving in a vortex around the magnet, and entering at one of its poles and issuing at the other: or, as M. Æpinus, a discrete fluid, susceptible of rarefaction and condensation, which is rarefied in one of the poles and condensed in the other; or, lastly, as M. Prevost*, two fluids, susceptible of being combined with each other in such a manner that one of them alone is accumulated around the north pole of a magnet, while the other is accumulated around the south pole; and that all the magnetic phenomena may be explained by the elective attractions which these fluids exercise either upon each other or on iron†.

* De l'origine des forces magnétiques, 8. Geneve 1788.

† The celebrated Coulomb admits also two fluids, which compose the magnetic fluid, and which exercise their action in the inverse ratio of the square of the distance: but, in the theory of phenomena connected with the action of the globe, this philosopher sets out from certain facts immediately given by observation; one of which it would be of importance to verify in different points of the globe. This fact is, that the forces which attract one of the poles of a magnetic needle

3. It must then be examined, whether the direction of the magnetic needle, and its inclination, depend on the situation of a large magnet enclosed in the bowels of the earth, as Halley supposes; or on the action of one of these two magnetic fluids towards one of the poles, and, perhaps, of the other fluid towards the opposite pole, as M. Prevost supposes.

4. If we admit the hypothesis of a large magnet suspended within the cavity of the earth, shall we suppose, as the inventor of this hypothesis, that this magnet has four poles? Or, shall we endeavour to explain the whole, as that great geometer Euler has done, by a magnet having only two poles? Or, lastly, shall we suppose, as Mr. Churchman, an American philosopher, has lately done, that the earth contains two magnetic poles, one at the north and the other at the south at different distances from the poles of the earth, which perform their revolutions in different times; and that, from the combined influence of these two poles, we may conclude the annual changes of the declination with so much precision, that we can deduce the longitude of any place from its latitude, and from the degree of declination which the needle experiences.*

5. Thus, by supposing one or more magnets in the interior part of the earth, the annual changes of the declination and inclination may be explained by the rotary

freely suspended towards the north, are equal to those which attract the opposite pole towards the south. Coulomb concludes that this equality exists, because a needle, weighed two different times, before and after it was magnetised, was found exactly of the same weight.

C. Borda has found, by observations made first at Brest, Cadiz, Teneriffe, Goree on the coast of Africa, and afterwards at Brest and Guadaloupe, that the intensity of the force exercised by the globe on the magnetic needle, estimated according to the number of oscillations made by the needle in a given time, was sensibly the same in these different places. This observation in other latitudes, especially on approaching the poles, might throw some light on the theory of natural magnetism.—Note of C. Hauy.

* Heads of Lectures by S. Priestley, London 1794.

movements of these magnets. But in the system, which does not admit these internal magnets, it is asked, Whether the changes of declination might not depend on movements which produce the change of obliquity, precession, nutation, and perhaps other phenomena or inequalities of that kind.†

6. With regard to diurnal variations, an English philosopher, Mr. Canton, considering that it is proved by experience that heat diminishes the force of the magnet, thought that the solar rays, by heating the earth, must lessen the attractive force of the grand magnet contained in it; and he thence deduced, as will be seen hereafter, an explanation of these variations. But Mr. Canton did not reflect on what was clearly seen by M. Æpinus, that this magnet, if it exists, is sunk to too great a depth in the earth for the action of the solar rays, or at least the variations of that action, in the morning and evening, to be able to penetrate to it. We may, however, apply to the ferruginous minerals, dispersed in abundance over the surface of the earth, what Mr. Canton supposed, in regard to the grand magnet contained in its bosom; and then, if we admit that these minerals exercise any action on the

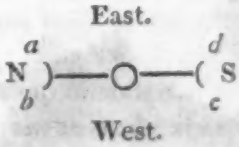
† Æpinus gives another explanation independent of these movements. It may be possible, according to this philosopher, that the declination of the magnetic needle arises, in general, from the irregular figure of the nucleus of the magnetic globe, or from an unequal distribution of the fluid in its interior part: and to account for the variation of this declination in one place, in the course of time we might suppose that the figure of the nucleus, or the distribution of the fluid it contains, is itself variable. Æpinus presumes also, that the action of the iron-mines dispersed throughout the bosom of the globe, may have an influence on the variation in question; and may, perhaps, be the sole cause of it. *Tentamen theoriæ electr. et magnet.* p. 268, 271, 334.

This philosopher wishes that men of science, who have an opportunity of being near a mine of loadstone, would determine, by observation, whether the masses of this mineral, before they are taken from the bowels of the earth, have their poles disposed, in regard to the poles of the world, like those of needles freely suspended: and whether, in certain masses, the poles are not in an inverse direction, of which he shews the possibility by means of consequent points. *Ibid.* p. 333.—Note of the same.

magnetic needle, we cannot deny that the heat, excited by the rays of the sun, may diminish that action. From these principles it would follow, that in the morning, when the sun warms the surface of the ground situated to the east of the needle, the latter, being less strongly attracted towards that part, ought to decline towards the west; and, for a contrary reason, it must in the evening decline towards the east. But Mr. Canton proved, by a long series of observations, that at London, at least, this is the ordinary course of the diurnal variations.

7. But it will be proper to examine whether this explanation, even thus corrected, does not contain a paralogism; and when the attractive force of all the ferruginous particles, dispersed over the surface of the earth, to the east of the needle, is diminished equally and simultaneously, the needle ought not to remain motionless; since the diminution of the attraction exercised upon the south-pole of the needle, compensates for the diminution of that exercised upon the north-pole.* I say the same thing of those situated to the west. If this reasoning be just, the needle ought not to vary by the action of the solar heat, but when this heat diminishes the magnetic force of the ferruginous parts situated to the north of the needle, more than that of the parts situated to the south, or reciprocally.

* Let O be the centre of suspension of the needle N. S., and *a*, *b*, *c*, *d*, the forces which attract the needle in opposite directions; for example, pieces of iron. The forces in *b* and *d* conspire to make the extremity N of the needle move towards the west; and the forces at *a* and *c* conspire in the like manner to make the same extremity proceed towards the east. When the needle remains at rest, there is an equilibrium, and the forces $a+c=b+d$. But in this supposition, if the forces of the same side, *b* and *c* for example, gradually diminish, the equilibrium will not be interrupted. For, let $b=y+m$ and $c=z+m$: if the forces *b* and *c* are equally diminished by the quantity *m*, we shall always have $a+z=b+y$. The case will be the same with any augmentation, if it be equal and simultaneous on all the sides of the needle. —Note of the Author.



To determine this curious question, it would be necessary to make choice of two opposite coasts, and directed almost east and west from the magnetic meridian; such as the coast of Provence to the south, and that of Normandy to the north; to establish two compasses well suspended, such as those of M. Coulomb, one to the south, at Antibes for example, and the other to the north, near Cape de La Hogue; and to see whether their diurnal variations did not proceed in a contrary direction: that is to say, whether that at Antibes, having the continent to the north, and only sea to the south, would not decline, in the morning, towards the west, as that of Mr. Canton did; and whether that of La Hogue, having the continent to the south and sea to the north, would not, at the same time, decline to the east. Mr. Canton, indeed, who made these observations at London, had, to the north of his magnetic horizon, the greater part of England and all Ireland; and thus he must have had the variation west in the morning and east in the evening, as he observed it; for it is certain that the sea preserves the land, which it covers, from the action of the sun; and that thus the attraction of that land ought not to vary by the heat which emanates from that luminary.

By carefully repeating and varying these observations, in places chosen with discernment, we shall be able to decide whether the regular diurnal variation depends upon a general cause, the action of which, however, is susceptible of being suspended or disturbed by local causes: or whether we are to believe, on the contrary, as M. Van Swinden does, that the diurnal variation is not a cosmic phenomenon, or that it does not depend on a general cause inherent in the globe, and which every where acts according to the same law.

9. Is there properly any action of the magnetic fluid on the electric fluid? or is there, between these two fluids,

only a resemblance of properties, or in their manner of action?

10. Is it well ascertained, as M. Van Swinden thinks, that the *aurora borealis* acts on the magnetic needle; and can any idea be formed of the mode of this action?

11. The same question in regard to the zodiacal light.

12. In general, the theory of the magnet is still so far from perfection, even in that part which depends merely on observation, that it is much to be wished that observers and observations were multiplied, especially in what concerns the inclination of the needle. In regard to the declination and its variations, M. Van Swinden has given a noble example of correctness, and of constancy in observations, and in the art of classing and comparing the results. It would be of great benefit if this example were followed in different situations and climates. It would be highly interesting, for instance, to determine, with precision, the zones of the earth where the declination is nothing, and where changes take place, and the same for the inclination.

CHAP. XXII.

Errors to be avoided in Observations respecting Geology.

1. THERE are some errors into which people may readily fall when they have not had long experience in any given kind of observation, and against which it is of importance to put beginners at least on their guard.

2. One may be readily deceived in regard to the relative distances of remote objects. All the stars and planets appear to be at an equal distance from us. Distant mountains all appear to be in the same plain. Thus those which are situated very far behind the rest, seem to form one body with them; so that people believe they see continued and uninterrupted chains when there are

really none, and where the mountains, on the contrary, are insulated.

The absolute distance of objects, even when not very remote, is equally difficult to be ascertained on high mountains, where the transparency of the air, and the absence of vapours, destroy the aërial perspective. I have often imagined that I had only two or three hundred steps to make in order to reach a summit, the distance of which from me was more than a league in a straight line.

3. There are a great many errors in regard to strata. Their great thickness may make one believe that there are none where they really exist. In the like manner, if the vertical strata, or those only very much inclined, present their planes to the eye of the observer, he will think he sees shapeless and indivisible masses; while, if their sections were seen, their divisions would readily be distinguished. A mountain then must be seen under aspects that intersect each other at right angles before we can pronounce that it is not divided by strata.

4. At other times accidental fissures, but produced however by a cause which is common to them, exhibit the appearance of strata when there are none: or when, if there are, their situation is very different from that of those strata. It is the internal tissue of the stone only which in many cases can determine whether the divisions observed are the interstices between strata or mere fissures; because the strata are constantly parallel to the internal laminæ, or schistous texture of the stone. Crystals, the lamellated texture of which may sometimes be confounded with a schistous texture, may afford an exception to this rule, by presenting laminæ perpendicular to the planes of the strata; but it is not difficult to distinguish them.

5. One may also form an erroneous opinion respecting

the direction of a mountain, or of its strata, when the eye is not situated in their prolongation, or at least near it.

6. The apparent situation of the strata may also lead into an error. They appear horizontal even when they are very much inclined, and when they are not seen but in a section formed by a plane parallel to the common section of their planes with the horizon. It is impossible to judge of their inclination, and to measure it with certainty, but on a section perpendicular to the common section, which I have just mentioned.

6. A. The greatest error, however, is that which may be committed in regard to the super-position of strata. I have often seen novices in the study of mountains believe that one stratum reposed on another; one of granite, for example, on one of slate; because they found slate at the bottom of the mountain, and granite at the top; while the slate was only laid against the base of the mountain, and the granite, on the other hand, was sunk in the earth far below the slate. We must not then say, that a stratum is situated below another, but when we really see it extending itself below it.

7. And even when we distinctly see a rock placed above another, we must examine whether that which is uppermost does not occupy that situation accidentally; whether it has not slipped, or rolled down, from a more elevated mountain; and, in the last place, though they may be closely connected, one must examine whether their present situation is really the same in which they were formed, and whether they have not been reversed, and united accidentally in a situation contrary to that of their original formation.

8. One is frequently deceived, also, in regard to the nature of stones and of mountains. Though a well-accustomed eye may often judge at some, and even a considerable distance, of the kind of stone of which a moun-

tain is composed, such judgment is however often erroneous: mountains of granite, or *gneiss*, tender and destructible, often assume, at a distance, the round form of secondary mountains; sometimes, also, mountains of calcareous stone, hard of their kind, and in strata either vertical or very much inclined, present the bold forms, the peaks, and sharp-angled indentations of the granite summits.

9. People are often deceived even on a near view. A stone may have a foreign covering of mica, for example, while the interior part is of a very different nature.

10. Effervescence with the nitrous acid is commonly considered as a certain character of calcareous stone; but this character may be deceptive, since barytes and magnesia effervesce also:* and we must not consider it enough to touch a stone with the nitrous acid, or to let fall a drop of the acid on its surface, since the absorbing earth, whatever it is, may be only disseminated between argillaceous or siliceous particles. We must therefore immerse a fragment of the stone in a quantity of the acid sufficient to dissolve it entirely, if it be wholly soluble, and observe whether there remains any residuum that withstands solution.

11. The action of the air and of meteors often gives fossils appearances absolutely different from those which they had before they were subjected to it. We must not then be satisfied with a superficial examination: we must sound the rocks to the quick where the action of meteoric agents has not penetrated.

12. People are often deceived, also, in considering compound stones as simple stones, when the composition of them does not manifest itself on the first view, either on account of the smallness of their composing parts, or be-

* And, on the other hand, there are calcareous stones which do not effervesce.

cause some of these parts are each inclosed separately in a covering which conceals the interior of them. One may guard against this error by observing the fossil in the sun with strong magnifying glasses, after having moistened its surface with water or the nitrous acid, and still better by exposing it gradually to the flame of the blow-pipe.

13. People are often deceived in regard to crystallisation, either in the true form of the crystals, or, above all, in taking for real crystals parasite crystals, or such as have been formed in the moulds made by crystals of another kind. Thus we see crystals of quartz, petro-silex, and jasper, formed in the moulds made by calcareous crystals, and which have assumed the form of the latter.

14. In regard to errors occasioned by ignorance of the distinctive characters of fossils, and of the names proper for them, the only means of avoiding such errors is to study with care good authors; and, above all, collections formed, or at least arranged and titled, by able mineralogists.

15. But when the slightest doubt is entertained in regard to the denomination which ought to be given to any fossil, an exact description must be made either of its external characters or its most striking physical properties, such as weight and solubility.* If this description is well drawn up, the error respecting the name may be rectified, and the observation will not be lost, as it would be were there any reason to suspect the justness of the denomination, and no means of correcting it by a description.†

* Hardness, refrangibility, electricity, &c. H.

† A person now dead, who in his time was considered as a mineralogist, wrote to me that he had found marine shells in granite. I begged him to give me an exact description of the stone which he called *granite*. He did so; but I perceived that the stone was a free-stone or sand-stone, and the specimens he afterwards sent me proved that I was not deceived. We may here recollect Re-

16. When the characters of a fossil give it such a likeness to another that it is found near the limits which separate the genera or species of these two fossils, we must follow the example of Werner and his disciples, by marking that this fossil is intermediary, or forms a transition from the one species to the other. For if we should ascribe it exclusively to the genus A, without noting the characters which bring it near to the genus B, another observer, on seeing the same fossil, might refer it to the genus B, and no one could know which of them was deceived.

17. People are often deceived also by mixing opinion with observation, and giving the former for the latter; as when people assert, that they have seen vestiges of extinguished volcanoes, because they have seen black or porous stones, or stones of a prismatic form, without deigning to describe them with care, but by qualifying them merely as *lava* or *basaltes*.

18. In the last place, a very frequent source of error is, too great a confidence in the fidelity of one's memory, or in the justness of one's first observations. These two kinds of confidence go often hand in hand; and people cannot guard against the errors, which are the consequence of them, but by noting down, on the spot, all observations to which any importance is attached, especially if they are a little complex, and carry away specimens, with their characters carefully marked upon them, of the objects that are the subject of these observations; for it is not specimens of rare objects merely that should be collected. The end, indeed, of the geological observer is, not to form a cabinet of curiosities, but he must carry away fragments

cupero's pyrites of Ætna. The errors of this kind, arising from false denominations, are innumerable; for an exact knowledge of mineral substances is more difficult to be obtained, and more rare, than is generally imagined.—Note of the Author.

of things apparently the most common, when an exact determination of their nature may be interesting to theory. People may thus employ, with advantage, the means of confirming or rectifying their first observations, and of making profound researches and comparisons impossible to be made on the spot*.

CHAP. XXIII.

Instruments neccessary for the Geological Traveller.

1. THE most necessary instrument is the miner's hammer. It will be requisite to have two, of different sizes: one small, to break small fragments of rolled pebbles, by holding them in the left hand while you strike with the right. Its weight, including the handle, ought to be about ten ounces. The other must be larger, to detach fragments of rock, and to break large pebbles: its weight ought to be quadruple that of the small one. When I travel on horseback, I have these two hammers suspended from the bow of my saddle.

1. A. Two stone-cutter's chisels: one small, of from

* We think it our duty to subjoin here some advice to travellers in regard to the questions which they may ask in the different towns.

Whence do they procure the materials proper for building; such as lime, plaster, tiles, slate, stones of different kinds, and sand? Do they burn turf or coal; and where are they found? Where do they procure their potter's clay, fuller's earth, the clay used for refining sugar, their whetstones and millstones? To observe with what the streets are paved; of what stones the steps of stairs are formed; marks for boundaries, &c.; and to learn from what place they are brought. To ascertain whether wells or the foundation of houses are dug; and whether there are in the neighbourhood any ravines or precipices. These questions will serve to facilitate the means of observing the nature of the ground, by pointing out the natural or artificial excavations that may exist in the neighbourhood, or which ought to be visited. For the same reason it is proper to examine the shores of rivers. It will be of use also to take a general view of the country from the tops of towers and of the highest steeples. It will be of some importance also to enquire, in the country, whether the inhabitants make use of lime, marl, plaster, coal, earth, or turf-ashes, for manuring their land; and from what places these substances are procured. *Til.*

a line to a line and a half, to detach small crystals, or other objects of small bulk; the other, seven or eight lines.

2. To try the hardness of fossils, a piece of steel to strike fire will be necessary; also a triangular file, pretty fine, and a strong bodkin of tempered steel.

3. Nitrous acid, with M. De Morveau's boxes of reagents.

3. A. An artificial magnet, in a case, with a steel pivot on which it can be placed, to try the magnetism of fossils.

4. A magnifying glass of three inches focus, in order to enable the observer to form a general idea of any fossil: another, of an inch focus, to examine its separated parts; and one of five or six lines for closer examination. These three magnifiers must be always in the traveller's pocket, or ready at hand: but, besides these, he must have, for his closet at home, a microscope furnished with a micrometer.

5. Telescopes, to observe inaccessible mines and distant mountains.

6. A pocket portfolio, with prepared paper for writing on with a pencil of tin solder, which it is not necessary always to cut, and the writing of which is not so easily effaced as that of plumbago. In this portfolio the traveller must write out, on the spot, the sketch of his journal, and insert such observations as occur to him; but he must take the trouble to transcribe these notes at more length, preserving the primitive notes, which will always retain a character of truth, and for that reason people are fond of recurring to them.

7. Some quires of brown paper, a few sheets of which may be carried in the pocket for wrapping up on the spot specimens of the stones you collect, the characters of which ought to be marked on the cover. You may afterwards

pack them with hay into a bag destined for that purpose, until you have a sufficient quantity to form a box, which you may send home by the public carriages wherever you find an opportunity; but, as it is fatiguing for the traveller to load his pockets during the time of his excursions, and as the guides often lose them on purpose in order to get rid of them, I have behind my saddle two leathern bags, into which I put them till I come to some halting-place, where I have time to pack them with hay into a bag. M. Besson recommends to those who undertake sea voyages to write with China ink the characters which ought to accompany minerals in long passages, because common ink may be effaced by accidents.

8. A blow-pipe, with its apparatus. As I make much use of this instrument, which at length fatigues me, though I can blow with my cheeks without exercising my breast, I caused to be constructed a pair of portable double bellows, the sides of which contain each sixty-two square inches. These bellows can be suspended from the edge of a table; and I put them in motion by pressing together, between my knees, the two handles, which afterwards separate by the action of the spring. This apparatus may be easily carried, and is very convenient.

9. A graduated semicircle traced out on a copper-plate of a form exactly rectangular, with a plummet suspended from the centre of the semicircle. This semicircle, is the most convenient instrument for measuring the inclination of strata, of veins and declivities; and it may always be carried in a pocket of the portfolio.

10. A compass, furnished with a cross staff, to find the direction of mountains, chains, vallies, and strata.

11. Portable barometers with two mercurial thermometers; one affixed to a barometer to estimate the temperature of the mercury in the latter, and the other with a bare bulb for measuring the temperature of the air. Those

who study meteorology, as well as geology, ought to be furnished also with an hygrometer and an electrometer.

12. For ascertaining the temperature of the sea, at great depths, it will be necessary to have a thermometer constructed like that described in my Travels through the Alps:* for lakes, an apparatus like that pointed out in the note of Section 1399, will be sufficient.

13. Those who understand a little geometry, ought to provide themselves with a sextant, having an artificial horizon, and also a chain, in order that they may be able to measure a base, and thus take the altitude of an inaccessible peak, the breadth of a river, &c. &c. With this sextant they may also find the latitudes. In regard to the longitudes, they require, besides instruments, an expertness in this kind of observation, which cannot be attained but by mariners or professed astronomers.

14. It will be necessary also to have within reach tools for repairing an instrument in case it should happen to be deranged; such as pincers, files, turnscrews, compasses, gimblets, wire, needles, thread, and packthread.

15. Lastly, some good map, pasted on canvas, of the country you propose to examine; and this map ought frequently to be compared with your itinerary, and the bearings given by your compass.

16. In regard to the care required for the traveller's person, he must have a light dress made of cloth, without lining, of a white colour, as well as his hat, that he may be less exposed to the heat of the sun's rays; with jackets, some cool for the warm regions and the vallies, and the other warm for the cool regions and eminences; a good great coat; green spectacles, and a black crape, to secure the eyes and face from the snow. Lastly, if he is to pass the night in the open air, a tent or *cannoniere*, a bear's skin to sleep upon, and woollen blankets.

Section 1392, Plate 1, fig. 3

17. A solid light walking-pole: mine for the high Alps is a young fir-plant, extremely dry, seven feet in length and 18 lines in diameter at the lower end, which is shod with iron tapering to a strong point. These dimensions may appear large, but nothing can be too strong for the steep rocks, glaciers and snow, when you are obliged to take your point of support at a distance from you, and to rest the whole weight of your body on your pole, by holding it in a situation very much inclined, and even horizontal, as may be seen in the Vignette to the First Volume of my Travels through the Alps.—For mountains which are not so steep, the traveller may be satisfied with poles of less strength and size; but it will still be necessary that they should be four or five feet in height, and sufficiently strong that a person might be able to support himself with his two hands by holding them in a horizontal situation, according to the attitude of the small figure which is on the left side at top of the before-mentioned vignette; for, in traversing or descending a rapid declivity, or in walking on the margin or edge of a precipice, the traveller must always support himself by his two hands, holding the pole towards the mountain, and not towards the precipice, as those do who have not learned the art of travelling through mountains.

18. To prevent slipping on the hard snow-ice, and grass-plats, which are still more dangerous, I would recommend iron cramps, such as those which I have caused to be engraved in the third plate of the first volume, and which I have long used with success. In my last excursions, however, I preferred shoes, the thick soles of which were armed with strong tacks, at the distance of eight or nine lines from each other. The heads of these tacks are of steel, and shaped like a square pyramid: I have some small ones, the points of which are only two lines and a half in height, and of about the same breadth, for the

snow-rocks and grass-plats; and others, of double these dimensions, for the hard snow.

19. In the last place, with regard to provisions, when the traveller must reside for a considerable time in the desarts, at a distance from habitations, and even huts, he may carry with him some salt or pickled meat; but M. Parmentier's saloop of potatoes, with cakes of portable soup, and bread, will form the most nourishing food, and what may be contained in the least room. A small iron chaffing-dish, a small bag filled with charcoal, and a pan of tinned copper or iron, form my kitchen apparatus for the mountains: wooden plates and spoons may be found in the remotest huts. It will be proper, however, to carry always in the pocket a cup of gum elastic, in order that the traveller may at all times easily quench his thirst, a want to which, he will be frequently exposed in his excursions.

From what has been said, it may be readily seen, that the study of geology will not suit the indolent or sensual; for the life of the geologue must be divided between fatiguing and perilous journies, in which he is deprived of almost all the conveniences of life, and the varied and deep researches of the closet. But what is still more rare, and perhaps more necessary than the zeal requisite to surmount these obstacles, is, a mind free from prejudice, filled with an ardent desire for the truth alone, rather than with a desire for raising or destroying systems; capable of descending to minute details indispensibly necessary for the correctness and certainty of observations, and of rising to grand views and general conceptions. Those fond of such studies, ought not, however, to be discouraged by these difficulties; there is no traveller who may not make some good observation, and bring with him at least one stone worthy of being employed in the construction of this grand edifice. It is indeed possible to be use-

ful without attaining to perfection; for I have no doubt that if the mineralogical travels, even the most esteemed, and much more those of the author, be compared with these Agenda, there will be found in them many deficiencies, and many observations, either imperfect, or even totally forgotten: but I have mentioned the reason in the Introduction. Besides, several of these ideas did not occur till I had finished my travels; and for that reason I laboured with more zeal on these Agenda, in the hope of rendering young persons, on their entering this career, capable of performing what cost me thirty-six years of travelling and study.

No. 58.

List of American Patents.

(Continued from Page 396).

1803.

Simeon Rouse, Jan. 1. Improvement in the caboose of a vessel for distilling fresh from salt water.

Gurdon F. Saltonstall, Jan. 4. A saw mill for cleaning cotton.

Christopher Hoxie, Jan. 7, machine for hulling rice.

Thomas Moore, Jan. 27, refrigerator for domestic uses.

J. Moffat, Feb. 1, boiler for accelerating the evaporation of liquids.

John Moffat, Feb. 1, improvement in stills.

Benjamin Cooley, Feb. 1, machine for raising water.

Jedediah Peasly, Feb. 1, manufacturing marle into lime.

Christopher J. Hütter, Feb. 11, making brandy out of all kinds of grain or fruit.

Moses Coats, Feb. 14, machine for paring apples.

Abel Stowel, Feb. 14, improvement in a gauge auger.

Elisha Bartlett, Oliver Bartlett, Otis Bartlett, and George Bartlett, Feb. 17, a machine for making hot wrought nails.

William Bell and John S. D. Montmollin, March 7, improvement to their patented roller cotton gin.

John Naylor, March 7, improvement in extracting a spirit from starch water.

Silas Bent, March 7, a wheel to turn under water.

John Baptiste Aveilhé, March 16, a horizontal wind mill.

Abraham Du Buc Marentille, March 18, a wreck raft.

Abraham Du Buc Marentille, March 18, a sea sitting chair.

John Staples, jun. March 18, a power obtained by the rising and falling of the tide, to give motion to all kinds of machinery.

John Staples, jun. March 18, submarine passage, or hollow inverted arch.

John Cottle, March 21, a machine for cleaning clover seed.

David F. Launay, March 21, an improvement in time pieces.

George Hunter, March 24, improvement in the process of manufacturing sea salt.

Peter De La Beharre, and J. B. M. Picornell, March 24, improvement in the mode of obtaining antiseptick gas.

Edward Marquam, March 28, improved house fan.

Thomas H. Rawson, April 4, antibilious pills.

J. Richardson, April 4, improvement in his evaporating furnace.

W. How, April 6, improvement in a cooler or condenser of vapour.

John Stevens, April 11, improvement in producing steam.

Daniel Brewer, April 22, improvement in a ruling machine.

B. Platt, April 27, improvement in heating and boiling water.

Eliphalet Beebe, April 27, improvement in the mode of constructing vessels with crooked keels.

Matthew Barney, May 4, machine for deepening channels.

William Hopkins, May 13, improvement in building boats.

G. F. Saltonstall, May 14, a rolling machine for cleaning cotton.

Daniel Ilsley, May 14, improvement in distilling spirits.

Richard French, and John T. Hawkins, May 17, improvement in cutting grain and grass.

John J. Hawkins, May 17, improvement in the pentagraph and parallel ruler.

Burgiss Allison, May 17, improvement in the application of the principle of rectifying or improving spirits.

John Clarke, May 19, machine for pumping.

John W. Godfrey, May 25, improvement in working the bellows of a furnace or a forge.

T. Alden jun. May 24, expediting the manufacture of common salt.

Lemuel J. Kilborn, June 4, improvement in the method of distilling or making alcohol.

J. Biddis, T. Bedwell, and W. Mitchell, June 7, improvement in extracting the effective matter contained in barks, &c., for dyeing.

David Morse, June 10, machine for making hinges.

Ezra Corning, jun. June 13, improvement in the manufacturing of hats.

Samuel Morey, Rufus Graves, and Giles Richards, June 15, improvement in the steam engine.

I. Tood, A. Day, and W. Bache, June 15, physiognotrace.

Walter Keeler, and James Waring, June 23, a rocking churn.

Benjamin Standring, June 28, a machine for breaking and carding sheep's wool.

L. Stanley, June 25, machine for shearing woollen and other cloths.

Nicholas Young, June 28, machine for pulling hair from skins.

William Ashbridge, June 28, improvement in the construction of iron cabooses.

Robert Heterick, June 30, improvement called the Columbia fire-place.

Samuel S. Camp, July 1, improvement in the mode of applying springs to window sashes.

Samuel Brown, Edward West, and Thomas West, July 8, improvement in distillation, by the application of steam in wooden or other stills.

John Clark and Evan Evans, July 20, machine for packing goods.

David Lownes, July 21, method of cooling liquors.

Do method of securing leaden or other pipes from frost, &c.

D. French, July 25, machine for splitting and shaving shingles.

George Keyser, July 27, improving in a powder mill.

Timothy Kirby, July 28, machine for separating clover seed from the "pod."

Lewis Geanty, Aug. 4, improvement in the construction of sills.

John Baptist Aveilhé, Aug. 24, machine for boring holes in rocks under water.

George Youle, Aug. 25, improvement in a water cock.

George Cleveland, Sept. 9, preparing seals' fur for hats.

Hezekiah Betts, Sept. 13, a wheel press.

John C. Stroebel, Sept. 19, mode of constructing carriages.

Daniel Coit, Oct. 15, family pills.

Lazarus Ruggles, Oct. 18, machine for making wrought nails and brads out of hot rods.

Jedediah T. Turner, Oct. 19, threshing machine.

Gilbert Livingston, Oct. 22, improvement in the construction of the keels of vessels.

Paul Pilsbury, Oct. 25. machine for shelling corn.

William Thornton, Oct. 28, improvement in boilers, also working stills with the same.

Samuel Goodwin, Oct. 31, a horizontal draft wind-mill.

Valentine Cook, Nov. 1, finding salt water and metals. *Bletonism!*

Samuel Cooley, Nov. 12, vegetable elixer, or cough drops.

Enoch Alden, Nov. 15, a dry bellows pump.

Amos Minor, Nov. 16, improvement in spinning wheels.

Asahel E. Paine, Nov. 19, improvement in wind mills.

Jacob Osborn, Nov. 24, improvement in fastening and supporting window sashes.

William Bell, Nov. 24, improvement in the cotton gin.

Do Nov. 25, improvement in the wind-mill.

Do Nov. 25, improvement in propelling boats for inland navigation.

John Fairbanks, Nov. 30, a cylindrick ruler for ruling paper.

Jacob Cist, Dec. 2, improvement in grinding painters' colours, printers' ink, &c.

Jos. Eve, Dec. 6, machine for separating the seed from cotton.

P. Earl, Dec. 6, a twilling machine for pricking leather for cards.

Stephen Seward, Dec. 6, improvement in a fire-engine.

Samuel Rogers and Melville Otis, Dec. 7, machine for rolling plates of iron and cutting them into nails.

James Curtis, jun. Dec. 10, improvement in window springs.

Edward Richardson, Dec. 16, improvement in still heads and condensers.

Joseph Elgar, Dec. 16, improvement in making cold cut nails and brads out of rolled iron.

David Buckman, Dec. 21, improvement in separating clover seed, wheat, &c. from the husk.

John Beverly, Dec. 26, a hydro-mechanical press.

John Selby, Dec. 20, improvement in painting rooms.

Francis Guy, Dec. 30, improvement in making colours for painting, printing, &c.

1804.

Nathaniel Miller and Philip W. Miller, January 5, machine for making brick and tile, by cutting the mortar.

Leonard Beatty, Jan. 19, improvement in stills or boilers.

Thomas Benger Jan. 25, improvement in preparing quercitron or black oak bark for exportation or home consumption, for dying or other uses.

Talmage Ross, Jan. 23, "a double draught fire-place."

William Wigton, Jan. 30, improvement in the construction of stills, and the procees of distilling spirits.

Oliver Evans, Feb. 14, improvement called the screw-mill for breaking and grinding different hard substances.

Oliver Evans, Feb. 14, improvement in steam engines, by the application of a new principle by means of strong boilers to retain and confine the steam, thereby increasing the heat in the water, which increases the elastick power of the steam to a great degree.

John Staples, jun. Feb. 17, improvement in wheels to be moved either by wind or water; for the purpose of giving motion to all kinds of machinery, mills, engines, carriages, ships, boats, &c. &c.

D. S. Dean, Feb. 20, improvement, being a machine for washing clothes, scouring, fulling, and cleansing cloth.

Israel Wood, Feb. 21, "in setting stills and other large kettles."

T. Barnett, Feb. 21, machine for threshing and cleaning grain.

T. Pierce, Feb. 21, improvement being a smut fanning-mill.

W.W. Hopkins, Feb. 24, improvement in hanging window sashes.

Wm. B. Dyer, Feb. 27, "improvement, being a spinning wheel and twisting-mill for the purpose of making cordage.

Jacob Worrell, Feb. 27, a machine for hulling clover seed.

D. M. Miller, March 5, improvement in air or bellows pumps for raising water.

Archibald Robertson, March 5, improvement, being a mode of preparing marble for painting on.

Daniel M. Miller, March 8, improvement in window fastenings, or springs for fastening and supporting sash-lights.

Samuel P. Lord, Jun. March 10, improvement in extinguishing fires in houses, &c.

Moses Smith, March 16, machine for watering cattle.

Ward Gilman, and Wm. Jackson, March 19, improvement in the bedstead, so constructed that it may be taken down and removed by one person, in case of fire, or on other occasions, with much ease and expedition.

Abraham Frost, March 19, machine for preparing what is commonly called top, and swingled tow for paper.

B. Tyler, March 19, improvement being a "wry-fly," which may be applied by wind or water to various machines, viz. grist-mills, hulling-mills, spinning-mills, fulling-mills, paper-mills, and to the use of furnaces, &c.

George W. Robinson, March 24, improvement in manufacturing coat and waist-coat buttons.

J. Williams, March 23, improvement, being an inclined-plane-

statical-wheel machine, for facilitating the passage of boats in canals, or for removing earth, stones, or heavy bodies from hills &c. by the inclined plane.

A. Hunn, March 24, machine for the improvement of navigation.

John Naylor, March 31, "improved still and boiler.

P. Daniel, March 31, improvement in the mode of making shot.

Owen Roberts, April 12, machine for breaking and cleansing flax and hemp.

Calvin Whiting, and Eli Parsons, April 14, improvement in the mode of working sheet tin into different wares.

J. Eaton, April 14, improvement in springs for window sashes.

Michael Garber, April 17, machine for slitting and heading nails.

J. J. Giraud, April 18, double steam-bath still.

P. Goltry, April 24, machine for cleaning flax-seed from cockle, yellow-seed, cheat, and all foul seed, which may be applied to separate wheat, rye, and other grains from each other, and all impurities.

Michael Withers, April 30, machine for shelling clover seed.

Moses Coates and Evan Evans, April 30, improved machine for cutting straw and hay, &c. &c.

Thomas Langstroth, May 1, improvement in paper-mills.

John Stickney, May 1, improvement in the construction of pump-boxes, or pumps, designed for the use of ships of war, merchant vessels, or other purposes where water is required to be raised.

S. Houston, May 3, Columbian threshing, break and cleaning fan.

Levi Stephens, May 8, machine to be fixed to the top of a common churn.

Levi Stephens, May 8, machine for shelling and cleaning corn, which may likewise answer the purpose of grinding tanners' bark, and provender for cattle and horses.

John Staniford, jun. and Amos D. Allen, May 10, improvement of the lantern.

A. D. Allen, May 10, composition for tablets to write or draw on.

Do machine to cut strips or chips of wood to make chip hats, bonnets, &c.

Edward Crafts, jun. May 12, furnace for making pot and pearl ashes, with the manner of using, and the materials of which the same is composed.

E. Weld, May 16, machine, or apparatus for making salt.

Jas. Simons and Jos. M'James, May 17, machine for cleaning and moating cotton after it has been ginned.

Burgiss Allison and Richard French, June 8, machine for making nails and spikes.

Asa Spencer, June 8, improvement in making thimbles.

William Tunstall, June 30, improvement in machines for clearing grain from straw, &c.

B. Folger, July 7, improvement in the mode of pumping and raising water.

Levi Osborn, July 12, improvement in the construction of the fulling mill called the double crank.

John Deaver, July 12, improvement in the plough.

Christopher Hoxie, July 12, improvement in the auger.

Thomas Power, July 12, improvement in the lime-kiln.

C. Veltenair, Aug. 10, metallick grinder, or hone for razors, penknives, scissors, surgeons' instruments, and all kinds of fine-edged tools.

Nicholas Boureau, Aug. 21, improvement in the machine for cutting nails.

Wm. Harrington, Aug. 28, machine for raising water from wells.

Hezekiah Betts, Aug. 29, improved windlass for ships or vessels.

John Roberts, Amos D. Allen, and Ezekiel Kelsey, Sept. 5, machine to cut chips or strips of wood to make chip hats and bonnets, brooms, baskets, sieves, matting, and for various other uses.

Emanuel Kent, Sept. 14, crushing plaster-mill.

Orange Webb, Sept 18, improvement in suspenders.

Richard Weems, Sept. 20, improvement in wind-mills.

J. Bolton, jr. Sept. 29, a wagon, or carriage, to be workedby hand.

John James Thomas, Oct. 2, method to prevent chimneys from admitting water in rainy weather.

Aaron Taylor, Oct. 4, forcing pump to raise water.

Abel Brown, Oct. 17, "the rheumatick liniment" for chronick rheumatism, strains, &c.

Simon Smith, Oct. 23, improvement in gallows, or suspenders, for breeches, pantaloons, or trowsers, &c.

Benjamin Dearborn, Oct. 29, improvement in candlesticks.

Laban Folger, Nov. 1, machine for breaking dough.

D. M'Mullin and T. M. Corby, Nov. 6, machine for cooling and filtering water or other fluids.

David Stodder, Nov. 16, composition, or cement, to prevent the roofs and other parts of houses from taking fire.

John Hooker, Nov. 19, improvement in sash springs.

J. Deneale, Jun. Nov. 20, improvement in the threshing machine.

J. White, Nov. 27, improvement in the oil press.

E. I. Du Pont de Nemours, Nov. 23, machine for granulating gunpowder,

S. Newton, Dec. 22, improvement in the cow or sheep bell.

Frederick W. Geyssenhayer, Dec. 22, machine for cutting nails with, and not across, the grain of the metal.

William Stanton, Jun. Dec. 26, improvement in wind-mills.

Isaac Scott, Dec. 26, "new invented window springs"

Nathan Fobes, Dec. 31, machine for boring gun-barrels.

Joseph Bellows, Jun. and Ebenezer White, Dec. 29, manufacturing ashes.

S. Chamberlaine, Dec. 31, medicine called "bilious cordial."

S. Janes, Dec. 31, mode of improving or setting a horse's ears.

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*List of English Patents.**

1797.

George Hodson, Feb. 23, improved method of separating the fossil or mineral alkali from various substances.

Thomas Oxenham, Feb. 28, portable lever-mangle for calendering linen, &c.

John Silvester, March 9, method of mashing and mixing malt, and all kinds of grain, for the purpose of brewing and distilling.

H. Goodwyn, March 9, mixing and mashing malt, and all kinds of grain used for the purpose of brewing and distilling, by means of an improved mash-tun and mashing-machine.

Wm. Sellars, March 11, machine for drawing out wool or flax, combed by hand, into a perpetual length or sliver, &c.

Wm. Siddon, March 14, method of screwing and fastening the hammer-springs and sear-springs to gun-locks and pistol-locks.

Edmund Bunting, March 25, method of producing a forward and retrograde motion, capable of being applied to mangles, pumps, calenders, rolling-presses, &c.

Robert Barber, March 25, improvement on the machine called a stocking-frame, otherwise the gigger stocking-frame.

Joseph Barton, March 25, preparing indigo for dying wool, silk, linen, cotton, &c.

John Passman, March 25, improvement in machinery for drawing, roving, spinning, wool, hemp, flax, silk, mohair, &c.

* Repertory, vol. viii.

END OF VOLUME FIRST.

William Brown, Printer, Philadelphia.